FALL 2014 VOL. 28, NO. 1

SYSTEMSOLUTIONS

THE INSTITUTE FOR SYSTEMS RESEARCH
A. JAMES CLARK SCHOOL of ENGINEERING

www.isr.umd.edu

Shining moments

PECASE Awards for Derek Paley and Sarah Bergbreiter and an NSF CAREER Award for Michael Rotkowitz

SEED GRANTS | SECURITY THEORY MURI | NEES EFRC RENEWED

director's message

Yet again ISR is evolving to prepare our community of researchers for the next generation of challenges. Our faculty are currently engaged in preparing a strategic plan that will guide ISR for the next five years. To help us think most effectively as a team, we would like to invite you to be part of this team effort. Send your ideas and other input to me at ghodssi@umd.edu this fall and be part of the strategic planning process.

Every so often a major convergence of disciplines happens in engineering, and at ISR we are in the midst of one right now—a convergence that takes advantage of faculty and students in fields for which ISR is already well known.

Throughout this issue of *System Solutions,* you can read about innovative directions in research that meld biology and engineering research in a systems approach.

It may be a new generation of robots inspired by how animals and insects move and interact with each other. It could be the ways in which nanotechnology is being combined with biological structures to create new energy solutions. Or how microfluidic devices combined with tiny engineered particles and new techniques are creating better ways to deal with medical problems. It might be the progress our researchers are making in unlocking the mysteries of the brain's development and information processing. Such research has both medical and technological applications.

ISR's proven strengths in neuroscience, microsystems and robotics have led to synergies where our researchers are crossing boundaries and disciplines, teaming with others within the University of Maryland as well as with medical researchers at the University of Maryland Baltimore, Maryland start-up companies incubated through MTech programs, and academic and industrial colleagues in the Big 10 and beyond. There are even more projects and ideas to come, which you'll be reading about in the next issue of *System Solutions*.

On that note, if you've been following ISR through *System Solutions* in the last few decades, you've noticed it—many of our stories chronicle ongoing research partnerships among our alumni, current faculty and students. In this issue, you can read about long-term projects of this nature involving robotic fish, major prize-winning threshold algorithm development for computer middleware, auditory cortex research published in the most prestigious journals, industrial partnerships forged with alumni who are now CEOs, and many more examples.

As ISR's 30th anniversary approaches, we remain committed to preparing students and supporting researchers to address the exciting systems challenges of the future. I invite you to be part of our strategic planning process!

Best regards,

IN THIS ISSUE:

Mpact Week: Oct. 16–22

The University of Maryland's Mpact Week showcases the broad theme of disaster resilience research. The event features keynotes, panels, research presentations, technology demos and startup venture exhibits. Events will be held both on the University of Maryland's College Park campus and in downtown Washington, D.C.

Thursday, October 16
Fischell Festival: Biomedical Emergency Response
Jeong H. Kim Building
University of Maryland

Friday, October 17
UAVs and Robotics for Disaster Response (a.m.)
Resilient Communications (p.m.)
Jeong H. Kim Building
University of Maryland

Monday, October 20
Energy Solutions for Mitigating the Effects of Climate Change
NOAA Center, College Park, Md.

Tuesday, October 21
Disaster Resilience—The Intersection of Research and Policy
Rayburn Building, Capitol Hill, Washington, D.C.

Wednesday, October 22
Multi-Hazard Resilience (a.m.)
Coastal Infrastructure (p.m.)
Jeong H. Kim Building
University of Maryland

LEARN MORE
www.eng.umd.edu/mpact

Paley, Bergbreiter win PECASE Awards

In December, President Barack Obama named Associate Professors **Derek Paley** (AE/ISR) and **Sarah Bergbreiter** (ME/ISR) recipients of the Presidential Early Career Award for Scientists and Engineers (PECASE). They were two of 102 researchers nationwide to win the highest honor bestowed by the federal government on science and engineering professionals in their early careers. Paley and Bergbreiter received their awards in a White House ceremony in March.

Paley received his award "For outstanding research achievements that apply methods from engineering and biology to the study of collective behavior in robotic and natural systems, and for dedication to teaching and mentoring students." The grant will support "Bio-Inspired Propulsion, Sensing and Control for a Novel Underwater Vehicle."

Paley, whose PECASE nomination was sponsored by the Department of Defense, directs the Collective Dynamics and Control Laboratory. He received the NSF CAREER Award in 2010 for dynamics and control of motion coordination for information transmission in groups. His research interests are in dynamics and control, including cooperative control of autonomous vehicles, adaptive sampling with mobile networks, and spatial modeling of biological groups.

Bergbreiter's PECASE nomination was sponsored by the National Science Foundation. Her research bridges work in systems and control with research in microsystems and fabrication.

She received the DARPA Young Faculty Award in 2008 for silicon/elastomer components for autonomous jumping microrobots and the NSF CAREER Award in 2011 for microrobot legs for fast locomotion over rough terrain. Bergbreiter is the principal investigator for the NSF Research Experiences for Undergraduates Program in Miniature Robotics and has been invited by the National Academy of Engineering to attend its prestigious Frontiers in Engineering Symposium this fall.

The PECASE awards, established by President Clinton in 1996, are given for pursuit of innovative research at the frontiers of science and technology and commitment to community service as demonstrated through scientific leadership, public education, or community outreach.

Three other ISR faculty, Elisabeth Smela (ME/ISR), S.K. Gupta (ME/ISR) and Don DeVoe (ME), have won the PECASE. All are associated with the Maryland Robotics Center.

PALEY AND BERGBREITER AT THE WHITE HOUSE PECASE CEREMONY.

Srivastava, Qu part of $7.5M security theory MURI

Professor **Ankur Srivastava** (ECE/ISR) and Professor **Gang Qu** (ECE/ISR) are part of a five-year, $7.5 million Multiple University Research Initiative (MURI) from the Air Force Office of Scientific Research, "Security Theory for Nanoscale Devices."

Ten researchers from the University of Maryland, the University of Connecticut and Rice University will collaborate in analyzing and updating security protections for nanoscale computer hardware. Their goal is to develop a universal security theory for evaluating and designing nanoscale devices. These devices, many thousands of times smaller than the width of a human hair, are increasingly being used to perform vital functions in computing.

Nanoscale chips are used in a wide variety of national security, commerce, energy, and transportation applications. They are found in everything from air traffic control computers to medical devices to personal cell phones and the nation's electric grid and banking system.

Srivastava and Qu bring to the MURI a combined expertise in hardware security, digital watermarking and fingerprinting for VLSI design, circuit and design obfuscation, design and implementation of physical unclonable functions, 3-D integrated circuit integration and manufacture-aware design.

"While developing hardware security for integrated circuit-based computer architecture has consistently grown over the past decade, research into the security of nanoscale devices has been very limited," says Srivastava. "Characterizing and modeling these devices, and gaining an understanding of likely attacks and developing security properties to foil them, will help us create far more secure devices."

"To date, any discovery identifying devices or features suitable for improving security has been based on an understanding of the individual primitives or properties of the devices," says Qu. "We currently lack both the capability to fully explain the effectiveness of existing techniques and the metrics to predict the security properties and vulnerabilities of the next generation of nanodevices and systems."

The research will address these gaps by developing a universal security theory for evaluating and designing nanoscale devices and developing innovative security primitives. The researchers' ultimate goal is to provide comprehensive first principles for design, evaluation, and security performance prediction of existing and next-generation nanodevices.

The University of Connecticut is the lead institution for the MURI, and the primary investigator is Mark Tehranipoor. Srivastava's former student and ISR alumnus Domenic Forte, an assistant professor at UConn, is also participating. Rice University, where Farinaz Koushanfar is the principal investigator, is the third academic partner.

Can't keep him away

ALUM KEVIN GALLOWAY CONTINUES HIS RELATIONSHIP WITH ISR

ECE PHD. STUDENT BISWADIP DEY AND ALUMNUS KEVIN GALLOWAY IN THE INTELLIGENT SERVOSYSTEMS LAB.

Why do so many ISR alumni continue working with each other and their former advisors long after they graduate? We asked alumnus **Kevin Galloway** (EE Ph.D. 2011) this summer, as he conducted collective behavior-influenced control theory research in ISR's Intelligent Servosystems Laboratory.

Systems Solutions: *Tell us a bit about your career trajectory. We've learned that in your family, not just you, but also all four of your brothers attended the U.S. Naval Academy.*

Kevin Galloway: That's right. My oldest brother started the trend, and then the rest of us chose the same path. I graduated from the Academy in 1997 and served on active duty until 2004.

SS: *Then you came to Maryland.*

KG: I started my Ph.D. work at Maryland when I went into the reserves in 2005, and completed it in 2011 (with a one-year hiatus in 2009 when I was recalled to active duty). My Ph.D. work with Dr. Krishnaprasad was in control theory, and my research was focused on the symmetry, reduction and nonlinear dynamics of cyclic pursuit.

SS: *After that, you did a postdoc at the University of Michigan.*

KG: I spent two years on a multi-university effort to develop a control Lyapunov function approach to stabilizing periodic orbits of hybrid systems with impulses. We verified this controller on a five-link robotic biped.

SS: *And now you are back at the Naval Academy—this time as part of the faculty!*

KG: I'm once again on active duty as a commander in the U.S. Navy, serving as an assistant professor in electrical and computer engineering at the U.S. Naval Academy. My military orders will conclude in August 2015, and I've recently accepted a (civilian) tenure-track position in the same department at the Academy, which will start at that time. It's a unique place and a great fit for me. It's been my dream job all along.

SS: What are your current research interests?

KG: I see myself in the middle of math, theory and its applications. My research is currently in collective control, the security of collectives and infiltrating collectives. These are interesting questions to me. Most research concerns have to do with "How do you get collectives to work together?" But my questions are, "What are the *security concerns* within collectives, and how does cybersecurity involve vulnerabilities?" So, my questions are networking questions, but also physical systems questions.

SS: *This summer you're back at ISR, visiting in the Intelligent Servosystems Lab. What are you working on?*

KG: I'm working with Biswadip Dey, one of Dr. Krishnaprasad's current Ph.D. students, to analyze motion in collectives where the agents are influenced by their neighbors as well as by some external source (such as a beacon).

SS: *Tell us what brings you back to ISR.*

KG: When Dr. Krishnaprasad was my advisor, I knew I had someone who would be a great mentor—and he still is a mentor to me today. We have gone from a relationship that was advisor/student to one that is now senior faculty/junior faculty. These days, Krishna is helping me develop my own research tastes. He encourages me to pursue what is interesting to me—they need to be my interests.

It's a real bonus for me that my position at the Naval Academy is so close to ISR and Krishna, and that I have a mentor I can still talk to who is both outside my current context and really cares about me and my career.

From Krishna I gained an appreciation for theory, its applications, and their beauty. When I was a Ph.D. student, I realized that no matter how hard I worked, Krishna was working harder. He loves his work, and that always comes through. It's this kind of environment that keeps me in touch with ISR.

KRISHNAPRASAD, GALLOWAY, JUSTH PUBLISH CHASING AND FLOCKING RESEARCH IN *PROCEEDINGS OF THE ROYAL SOCIETY A*

Galloway, fellow alumnus **Eric Justh** (EE Ph.D. 1998, currently an electronics engineer at the Naval Research Laboratory) and Professor **P. S. Krishnaprasad** (ECE/ISR) recently published collective behavior research in the *Proceedings of the Royal Society A*. The paper is a example of former students continuing to collaborate with their faculty mentor on high-level research years after graduation.

"Symmetry and reduction in collectives: cyclic pursuit strategies" explores how strategies, feedback laws and attentional graph structure influence collective dynamics space-time evolution. The researchers developed nonlinear dynamical models and a family of equations that can help analyze collective behavior that emerges from the actions of individuals. These action strategies are leading to biologically plausible modes of pairwise interaction.

Using interaction symmetries and reduction of the dynamics to the shape-space of the collective, the authors derived solutions predicting spatio-temporal patterns. They also elucidated the influence of control parameters on collective behavior.

"The special solutions to these equations yield behaviors consistent with biological settings such as flocking birds, foraging dolphins and ant mills," says Krishnaprasad.

These insights from nature can be used to create algorithms for networked unmanned aerial or ground vehicle robots that work together for a collective purpose.

"We are providing a framework for designing control strategies to generate coordinated maneuvers without requiring unrealistic communication and sensing capabilities," Galloway says.

International partnership leads to *Nature Communications* publication

Collaborative research made possible by an ISR-facilitated international partnership agreement between the University of Maryland and the Autonomous Province of Trento, Italy, has resulted in the publication of "Integrating artificial with natural cells to translate chemical messages that direct *E. coli* behavior" in *Nature Communications*.

The research into controlling living cells through communication with artificial cells was conducted by the groups of Professor **Sheref Mansy** at the Centre for Integrative Biology, University of Trento; and Professor **William Bentley,** chair of the Fischell Department of Bioengineering (BioE).

A graduate student exchange program facilitated the research. Maryland's **Jessica Terrell** (BioE) travelled to Trento and worked in Mansy's research group, while Mansy's advisee, **Roberta Lentini**, worked in Bentley's Biomolecular and Metabolic Engineering Labs. Lentini developed an artificial cell that can respond to a quorum sensing signal [molecule], autoinducer-2, while Terrell built one that can synthesize and deliver autoinducer-2.

Attempts to control cell behavior have relied on genetic engineering, but modifying a living cell's genetic content often changes its behavior. So the researchers developed artificial, nonliving cellular mimics that could activate or prepress already-existing natural sensory pathways of living cells through chemical communication.

The researchers worked to engineer *E. coli* by targeting its sensory pathways. They built artificial cells that could evoke a behavioral response by releasing a molecule to which *E. coli* naturally responds, sending a recognized chemical message.

"This changes the way we can program living cells," Bentley said. "Synthetic biology is stuck on the idea that to modify cellular behavior, the genetic content must be changed. Our approach transiently and safely directs the function of natural cells using signaling molecules manufactured and sent by artificial ones."

"This is a completely different way to approach synthetic biology," Mansy said. "We can engineer nonliving, artificial cells that do many of the things that we are after and bypass many of the problems people have with living technologies."

"Imagine having an infection and being offered two different therapies," Mansy said. "One is engineered bacterium. The other uses nonliving, artificial cells. Would you want to ingest something living that reproduces and evolves? Or would you prefer a nonliving mimic that does what's needed for a couple of hours and that's it?"

"Artificial cells are powerful because they contain the machinery to transcribe and translate genes into proteins, all housed inside a protective lipid bilayer, just like a true cell—yet they are not alive," Terrell said. Since artificial cells are built simply with a limited number of components, they are relatively easy to design and control.

Next steps include applications that could benefit from artificial cells, especially therapeutic or remediation strategies for maintaining and restoring natural stasis.

MORE EXCHANGES

The Trento-UMD international partnership also has funded projects in solar power and ultra-low power systems. Five graduate students in addition to Terrell and Lentini have participated in exchanges.

Maryland students at Trento

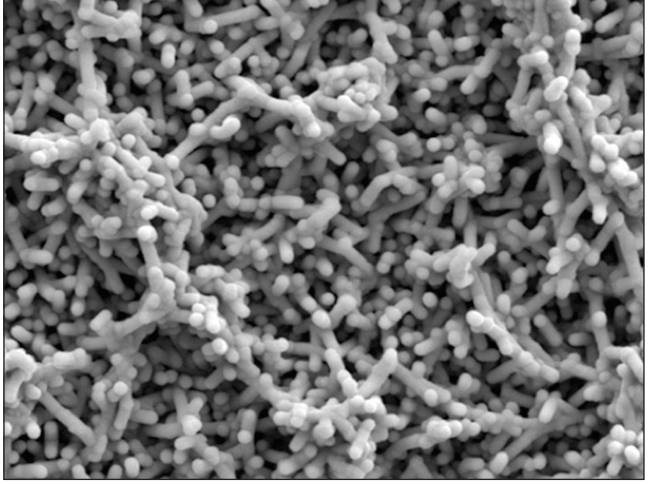
Kimberly Ferlin, a student of Professor John Fisher (BioE), worked with Simona Cassarosa at the University of Trento on tissue engineering and cell replacement strategy. Amy Marquardt, a student of Professor Ray Phaneuf (MSE), worked with Massimo Bersani of the Fondazione Bruno Kessler (FBK) on SIMS characterization for developing a kinetics model for the corrosion and tarnishing of cultural heritage metal objects and optimization of atomic layer deposited diffusion barrier films. Andrew Berkovich, a student of Associate Professor Pamela Abshire (ECE/ISR) worked with Massimo Gottardi of FBK on developing a novel demonstration of a vision sensor.

Trento students at Maryland

Maria Secchi, a University of Trento student advised by Massimo Bersani of FBK, worked with Professor Ray Phaneuf (MSE) on atomic layer deposition of nanometric films for the control of ion implantation induced nano-voids in germanium and for their functionalization. Alice Tomaselli, a student of Emanuella Bozzini at the University of Trento, worked with Professor Reginal Harrel (Environmental Science & Technology) on seed-saving practices, specifically how agricultural tradition-economic interest-knowledge (biotech industries and seed banks) can influence the attitudes of stakeholders.

UMD-TRENTO EXCHANGE STUDENTS. TOP, L-R FROM UMD: AMY MAQUARDT, ANDREW BERKOVICH, KIM FERLIN, JESSICA TERRELL. BOTTOM, L-R FROM TRENTO: ALICE TOMASELLI, MARIA SECCHI, ROBERTA LENTINI.

U.S. Department of Energy renews NEES EFRC



EXAMPLE OF NEES EFRC BATTERY RESEARCH: SEM IMAGE AT 50 KX OF TiN AND RuO_2 DEPOSITED BY ATOMIC LAYER DEPOSITION ON TMV-1Cys TEMPLATED NICKEL. FROM THE *JOURNAL OF MICROMECHANICS AND MICROENGINEERING* ARTICLE, "SOLID FLEXIBLE ELECTROCHEMICAL SUPERCAPACITOR USING *TOBACCO MOSAIC* VIRUS NANOSTRUCTURES AND ALD RUTHENIUM OXIDE," BY M. GNERLICH, E. POMERANTSEVA, K. GREGORCZYK, D. KETCHUM, G. RUBLOFF AND R. GHODSSI.

The U.S. Department of Energy's (DOE) Basic Energy Sciences has renewed its support for the University of Maryland's Nanostructures for Electrical Energy Storage Energy Frontier Research Center (NEES EFRC) for four years. The renewal is based both on the NEES EFRC's achievements to date and the quality of its proposals for future research.

Professor **Gary Rubloff** (MSE/ISR) is the director of NEES, and Professor **Sang Bok Lee** (Chem&BioChem) is its deputy director.

NEES EFRC is a multi-institutional research center, one of 46 EFRCs established by the DOE in 2009. It develops highly ordered nanostructures that offer a unique testbed for investigating the underpinnings of storing electrical energy.

The center studies precise structures—each at the scale of tens to hundreds of nanometers and ordered in massive arrays. These structures are also multifunctional, able to conduct electrons, diffuse and store lithium ions, and form a stable mechanical base. The scale and control of experimentation gives NEES EFRC researchers an exclusive gateway to probing fundamental kinetic, thermodynamic, and electrochemical processes.

In its first five years, NEES EFRC has developed a unique way of looking at the science of energy storage. "Our agenda for NEES-2 is at least as creative and relevant," Rubloff said.

"Our vision is a new generation of much better batteries; powerful and long-lasting because they are based on carefully designed nanostructures," Rubloff said. "This requires that we understand how to precisely control the multiple components (materials and shapes) of the nanostructures; how to densely pack and connect the nanostructures; how they individually and collectively behave during charging and discharging, and why; and how to make them safe and long-lasting over thousands of charging cycles."

Maryland faculty involved in NEES EFRC include Sang Bok Lee in the "Multi-functional Nanostructures for Fast Ion Transport" research area; **John Cumings** (MSE), **Chunsheng Wang** (CheBE), and **YuHuang Wang** (Chem&BioChem), in the "Self-Healing Nanostructures for Electrodes" research area; and Gary Rubloff, ISR Director **Reza Ghodssi** (ECE/ISR), **Liangbing Hu** (MSE), and **Janice Reutt-Robey** (Chem&BioChem) in the "Nanoscience of Electrochemical Interfaces and Atomic Scale Mechanics and Kinetics in Heterogeneous Nanostructures" research area.

Magnetic nanoparticle drug delivery holds promise

ISR researchers are working on projects that advance the promise of magnetic nanoparticle drug delivery for medical use.

Otomagnetics has designed a minimally invasive technology that directs and delivers therapeutics to the body's hard-to-reach destinations. Led by Professor **Benjamin Shapiro** (BioE/ISR), the UMD-related startup company includes ISR Associate Research Scientist **Didier Depireux**, David Beylin and Irving Weinberg, M.D. Otomagnetics recently won awards from the Advanced Medical Technology Association and Maryland's Department of Business and Economic Development to support the commercialization of its magnetic drug delivery system, which noninvasively directs biocompatible nanoparticles and their therapeutic payloads through tissue.

The goals for this "magnetic syringe" technology are to treat middle and inner ear conditions such as sudden hearing loss, tinnitus and middle ear infections. Other potential markets include drug delivery to the eye, teeth, and the treatment of neurodegenerative diseases.

"We want to move magnetic delivery technology from the lab to the market so it can help patients," says Shapiro.

Magnetic nanoparticle drug delivery also someday could be used in dentistry to lower the number of root canals performed.

Depireux and Associate Professor Radi Masri at the University of Maryland School of Dentistry have teamed on a grant from the National Institutes of Health's National Institute of Dental and Craniofacial Research for "Magnetic Delivery of Therapeutic Nanoparticles to the Dental Pulp."

Pulpitis is an inflammation of the pulp deep within the tooth, experienced as a sharp pain when eating something cold. Usually treatment involves the dreaded root canal procedure that removes damaged pulp. Depireux and Masri's research could give dental practitioners a much less invasive treatment option that would deliver medication directly into the center of a tooth.

The research uses strong magnetic fields to move medication-coated, magnetic nanoparticles through the tooth's dentin and into the pulp. The researchers use tubules (microscopic channels that travel through the dentin into the tooth pulp) to deliver the inflammation-reducing or antibiotic medication. By manipulating cube-shaped magnets, they can control the magnetic field to pull the nanoparticles into the tooth pulp.

The system could deliver both anti-inflammation and antibiotic medication. Even though the nanoparticles are tiny, they are able to deliver a large enough dose for medications to be effective.

"We've been treating pulpal inflammation the same way for decades," Masri says. "This is a contemporary approach to an age-old problem."

Animal-borne wireless sensor network could help endangered species

The first trial of a new data gathering system that will someday help to protect endangered species relied on the help of some surprised but cooperative white-tailed deer in the foothills of the Shenandoah mountains in early December.

The test was part of a cooperative project among researchers from the University of Maryland, the National Geographic Society and Princeton University called "Remote Imaging of Community Ecology via Animal-borne Wireless Networks." The four-year, $1.8M National Science Foundation grant was awarded to the team in 2011. Associate Professor **Nuno Martins** (ECE/ISR) is the principal investigator from Maryland; the team also includes **Greg Marshall** of the National Geographic Society and alumna and Princeton University Professor **Naomi Leonard** (EE Ph.D. 1994).

The "animal-borne wireless sensor network" consists of devices animals can wear to capture video, sound, geolocation data, and other information. The project is building a broad foundation of knowledge about how to design and optimize the algorithms that control these devices for monitoring animal behavior and better understanding and modeling the mechanisms of social interaction. This data will one day provide scientists with valuable information about the group behavior of endangered species and help to protect them.

During the test, animal experts from the Smithsonian Conservation Biology Institute at Front Royal in Virginia humanely caught 10 deer, then outfitted them with special collars bearing the wireless devices. The deer then went about their normal lives for the next 12 days while the devices recorded their geographical location once a minute.

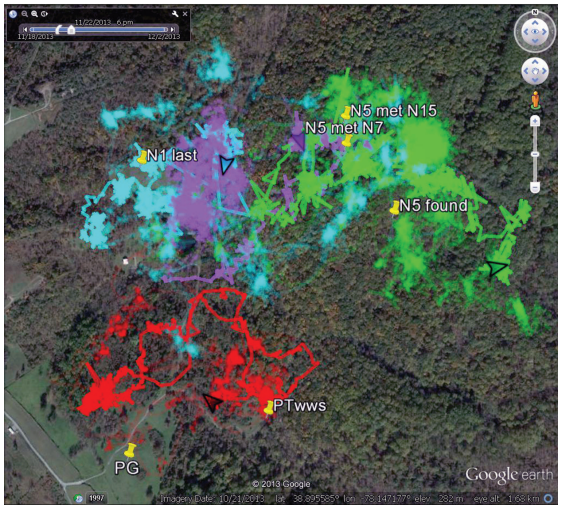
Because the wireless devices were networked, when the outfitted deer came within 30 feet of each other, video and audio recording was triggered and interactions were captured. At the end of the test, timers in the collars triggered their release, and they dropped off the deer. Researchers then returned to the deer's last known location and retrieved the devices and their data.

The gigabytes of data on the retrieved devices revealed the movement and interactions of the deer, says Postdoctoral Researcher **Konrad Aschenbach** (EE Ph.D. 2011). Because each device included an accelerometer, a gyroscope and a magnetometer (compass), the researchers were able to crunch the data and determine what kinds of recording document "normal" behavior for a deer—e.g. when it is walking around looking for food—and what reveals more unusual behavior. This includes the deer warding off another deer, being preyed upon or running away from danger, or otherwise experiencing an unusual event in its life.

Such differentiations will be important in the project's next phase. The researchers will be optimizing the device so the video and sound recorders (which are the most battery-intensive) only are triggered during unusual events, thus prolonging battery life and the length of time the collar can be deployed. Eventually, the researchers hope to be able to use the collar for a month at a time.

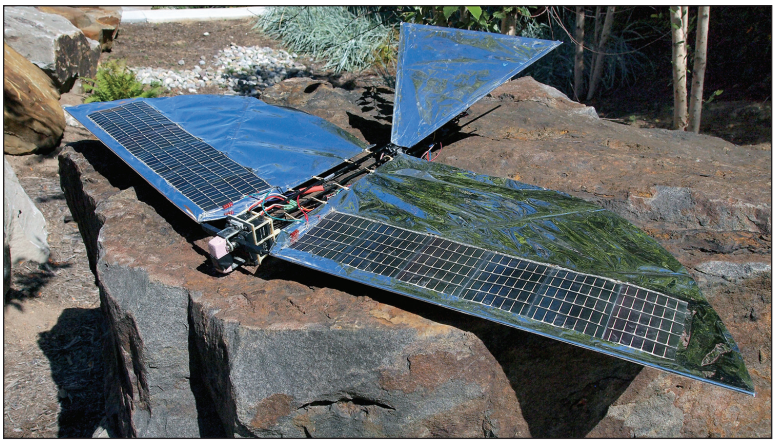
"This grant is creating unique opportunities to develop research that combines theory with practical application, algorithm design, hardware integration, testing and real experiments," says Martins. "It also is providing unique undergraduate research opportunities that are attracting some of our best students, such as **Joshua Drubin** who began working on this project in 2012." [In 2013, Drubin was part of the undergrad team that won the MHacks "hackathon" at the University of Michigan.]

The ultimate goal is to build collar devices that could be carried by a variety of small and large prey and predator animals, such as bears, coyotes, bobcats, and caribou, Aschenbach says. When perfected, the devices could record moments of predation, giving scientists a better understanding of wild species behavior, in particular who is preying on whom. This is of particular interest in Canada, where caribou populations are dropping, but the predator animal feeding on caribou calves is not known.



TOP TO BOTTOM: A DEER OUTFITTED WITH THE COLLAR; A DEER'S-EYE VIEW OF AN ENCOUNTER WITH ANOTHER ANIMAL; GPS TRACKING DATA FROM FOUR COLLARS SHOWS TERRITORIES AND MOVEMENTS.

Bio-inspired robots crawl, fly, swim... and go, go, go!



ROBO RAVEN, NOW WITH SOLAR-POWERED WINGS.

GREG KRUMMEL AND ROBO CRAB.

ISR's Maryland Robotics Center is home to many kinds of robotics research across campus. In this issue of *System Solutions* we're highlighting some of the bio-inspired robots created by our faculty and students.

Robo Raven is now solar powered

The latest versions of the Robo Raven micro air vehicle (MAV) incorporate solar panels in its wings.

While the solar panels don't produce enough energy to power Robo Raven III in flight (they produce around 3.6 Watts while Robo Raven needs around 30 Watts to fly), they are effective in charging the MAV's batteries when it is stationary.

The development team of Professors **S.K. Gupta** (ME/ISR) and **Hugh Bruck** (ME) and their students envisions Robo Raven flying "far away from civilizations" during long missions and needing "a way to 'feed' itself" on its journeys.

Robo Raven's large wings have enough surface area to create a usable amount of solar energy. The captured solar energy is then used to supply Robo Raven's onboard batteries. "These multi-functional wings will shape the future of robotic birds by enabling them to fly longer, farther, and more independently because they will be getting their power from the sun" says team member and ME Ph.D. student Luke Roberts.

Gupta has been working on flapping-wing robotic birds since 2007, when his team first successfully demonstrated a flapping-wing bird.

Greg Krummel wins award for Robo Crab

Alumnus **Greg Krummel** (ME B.S. 2014), an undergraduate student who worked with **Professor S.K. Gupta** (ME/ISR), won an Engineering Honors Program Outstanding Research Award for his honors thesis paper, "Development of a Horseshoe Crab-Inspired Robot for Surf Zone Traversal." Krummel described how horseshoe crabs' shapes, morphology and locomotion methods help them navigate sand, surf and water. He adapted these features into a robot that can travel in sand and water, and rights itself when it is flipped over by a wave in surf-zone turbulence. It employs many of the features and strategies real horseshoe crabs use when moving from beaches through surf and into the water.

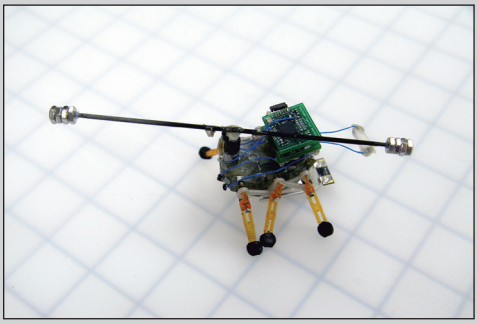
R2G2 moves like a snake

Snakes usually travel by bending their bodies in the familiar S-pattern. But when they're stalking prey, snakes can move in a straight line by expanding and contracting their bodies. This "rectilinear gait" is slow, but it's quiet and hard to detect —a perfect way to grab that unsuspecting rodent.

Roboticists have long known that this kind of "limbless locomotion" is a highly effective way for a robot to move through cluttered and confined spaces. But like snakes, robots that employ rectilinear gaits are slow.

NSF'S 'TINY BOT LEGS' VIDEO FEATURES BERGBREITER'S LAB

Associate Professor **Sarah Bergbreiter's** (ME/ISR) robotics research recently was featured in the National Science Foundation's online magazine *Science Nation*. "As fast as their tiny 'bot' legs will carry them!" highlights Bergbreiter's NSF-funded research in building insect-inspired microrobots.



A "TAIL-BOT" CREATED IN THE MICROROBOTICS LAB.

Bergbreiter is creating robotic legs capable of traversing rough terrain at high speeds or jumping like real insects. Bergbreiter tests materials on larger robots before scaling down to the micro size. Someday the microrobots will be used as mobile sensor platforms that can move quickly for a variety of purposes, such as searching through small cracks in rubble after natural disasters, providing low-cost sensor deployment and engaging in stealthy surveillance. **Watch the video at *ter.ps/sstinylegs*.**

They also have a problem maintaining traction on steep slopes.

For his dissertation, alumnus **James Hopkins** (ME Ph.D. 2014) worked to overcome speed limitations of engineered limbless locomotion. A dramatically exaggerated gait increased the speed of his "R2G2" (Robot with Rectilinear Gait for Ground Operations).

"R2G2 has a maximum forward velocity of one mile per hour, bringing it close to human walking speed," says Hopkins. "The goal is to develop a gait and a mechanical architecture that will enable high-speed limbless locomotion to support applications such as search and rescue."

THE R2G2 SNAKE-INSPIRED ROBOT, DESIGNED BY JAMES HOPKINS.

"To the best of our knowledge, this is the fastest limbless robot in its class in the open literature," says Hopkins' advisor, Professor **S.K. Gupta** (ME/ISR).

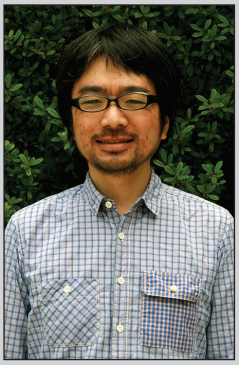
R2G2 could get faster. "In this design, the speed is linearly proportional to the length of the robot. So by doubling the length we should be able to easily achieve the speed of two miles per hour," Gupta says. To get much above that speed, R2G2 will need an upgrade to more powerful motors.

R2G2 can more through spaces that are problems for other kinds of robots. It can crawl through pipes, and traverse tricky surfaces like grass and gravel. What's more, "it can climb steep, narrow inclines," Hopkins says.

Hopkins used actively actuated friction pads near the head and tail of the robot to improve its traction, and has found that different terrains require unique kinds of friction pads—a bed of nails for traveling over grass; rubber for carpets.

More than 100 Maryland Robotics Center videos are online at *youtube.com/umdrobotics.*

Toshiba visiting scientist works on production control



KEIICHIRO URAYAMA

Mr. Keiichiro Urayama is the 18th engineer from Toshiba Corp. to conduct research as a Visiting Scientist with ISR faculty. He works in the Information System Research Center in Toshiba's Corporate Manufacturing Engineering Center. Urayama is working on a joint project with Professors **Steve Marcus** (ECE/ISR) and **Michael Fu** (BGMT/ISR) to study manufacturing production control for Toshiba's major semiconductor fabrication facility.

ManTech scholarships provide resources for MSSE students

In Fall 2013, the Institute for Systems Research awarded the first ManTech International Corp. Master of Science in Systems Engineering Scholarship to second-year M.S. in Systems Engineering student **Alan Nguyen**. Nguyen, who graduated in May 2014, now works as a business data analyst for Constellation, Inc. He was advised by Associate Professor **Mark Austin** (CEE/ISR).

ManTech has provided two additional scholarships for outstanding students starting their MSSE studies in Fall 2014:

- **Tom Oeste** comes to the program from the University of Maryland and will study systems engineering for robotics.
- **Connor Tobias** comes from the University of Massachusetts Amherst and is interested in system engineering for manufacturing systems and operations research.

The ManTech-supported scholarships are making a difference in students being able to enroll in the MSSE program. ISR thanks ManTech for its generous support.

ENES 489P features design competition

In Fall 2013, the capstone course ENES 489P, "Hands-On Systems Engineering Projects" added an undergraduate systems engineering design conference to its curriculum. The new feature was pioneered by Associate Professor **Jeffrey Herrmann** (ME/ISR), who taught the class that semester, and was continued by Professor **John Baras** (ECE/ISR) in Spring 2014.

In the competition, teams of undergraduate students present the results of their model-based systems engineering design projects for judging by a distinguished panel of high-level experts from industry and government. Judges have come from ManTech International Corp.; Excela Ventures; the National Transportation Safety Board; Northrop Grumman Electronic Systems Sector; TASC, Inc.; Hughes Network Systems; Lockheed Martin Corp.; and the National Institute of Standards and Technology.

The top teams are awarded prizes sponsored by ManTech International Corp. and in the spring, by Dr. Baras.

Maryland hosts FIRST Robotics competition

The University of Maryland, the Clark School of Engineerng and the Maryland Robotics Center hosted the Chesapeake Regional FIRST Robotics Competition this spring at the Comcast Center. More than 2,000 high school students, their mentors, teachers, family and fans flocked to campus to check out the action.

The student teams came from seven states, the District of Columbia, and Ontario, Canada. Before arriving in College Park, they had spent six weeks preparing for the competition game, AERIAL ASSIST. With guidance from technical mentors, the teams designed, built and programmed robots to play the 3-on-3 game of passing balls and scoring goals. Of the six teams that advanced to the championship round, three were from Maryland.

Winners from the Chesapeake Regional FIRST Robotics Competition went on to compete in the FIRST Championships in St. Louis later in the spring.

Research and Innovation Seed Grants team ISR and University of Maryland Baltimore faculty

Research and Innovation Seed Grants are awards given by the University of Maryland and the University of Maryland Baltimore as a component of the broad "MPowering the State" strategic partnership. The grants are awarded to teams of researchers from the two institutions who work together across disciplinary boundaries.

Simon, Hong to study auditory hallucinations in schizophrenia

Professor **Jonathan Simon** (ECE/Biology/ISR) and **Dr. Elliot Hong** (Psychiatry) of the University of Maryland Baltimore have won a 2014 Research and Innovation Seed Grant for "Temporal Auditory Coding in Schizophrenia and Treatment-Resistant Auditory Hallucination."

Simon and Hong will investigate the neural processing of rhythmic sounds in schizophrenia patients with treatment-resistant auditory hallucinations. While not entirely unique to schizophrenia, experiencing auditory hallucinations with certain characteristics is diagnostic or strongly indicative of having schizophrenia.

There is a debate on the hallucinations' origin. Are they caused by erroneous processing of diverse external auditory inputs? Or are they from attentional deficits or due to a failure to appropriately segregate and communicate internally-generated contents with the primary auditory pathway, leading to aberrant auditory perception? The work will advance schizophrenia research.

Shapiro, Martin researching cancer cells' 'microtentacles'

Professor **Benjamin Shapiro** (BioE/ISR) is teaming with Associate Professor **Stuart Martin** of the University of Maryland Baltimore School of Medicine.

Their project, "Touch-free manipulation of live cancer cells to observe their tumor-formation and drug response behavior," will study microtentacles on cancer cells using a novel technology.

Cancer spreads when cells detach from a primary tumor, enter the blood stream, circulate, and then reattach in distant locations in the body to form new tumors. The process by which circulating tumor cells grab blood vessel walls, crawl out, and form new tumors is thought to involve "microtentacles." Until now, it has been difficult to study microtentacles; cells are usually placed on a microscope slide for imaging, and doing so makes the microtentacles retract.

In this project, instead of putting cells on slides, live cells are kept in place for imaging by flow control. Whenever a cell starts to drift out of view, the media surrounding the cell is flowed in the opposite direction to keep the cell in view and under observation. This feedback control will be used to monitor single cells, and to observe their microtentacles as cells grasp surfaces, including each other, with and without the presence of cancer drugs. The end goal is to understand which drugs can be used to combat microtentacles, and thus the ability of cancers to spread throughout the body.

Kanold, Krueger studying brain development and autism

ISR-affiliated Associate Professor **Patrick Kanold** (Biology) is teaming with Professor **Bruce Krueger** (Physiology/Psychiatry) of the University of Maryland Baltimore School of Medicine.

Their project, "The role of early brain circuits in autism," studies how errors in brain development during early pregnancy may contribute to autism. During the first trimester, the first neurons of the cerebral cortex and hippocampus are generated and form primitive neural circuits that are transformed into the complex circuitry of the mature brain. Errors in these developmental processes are postulated to cause autism.

The incidence of autism is 10-fold higher when the mother takes the anti-epileptic and mood-elevating drug, valproic acid (VPA), during early pregnancy. Similarly, when VPA is administered to pregnant mice, their offspring develop autistic-like symptoms; consequently, fetal VPA exposure is a widely-used animal model for the disorder.

Kanold and Krueger will examine the effects of VPA on the production, migration and survival of newly-generated neurons in the fetal mouse cortex and hippocampus (Krueger), as well as the formation and function of early cortical circuits comprising these neurons (Kanold). The research will provide a clearer understanding of the causes of autism and may lead to improved strategies for its prevention.

Desai, Fermuller, Westlake developing 'GraspVis'

ISR-affiliated Professor **Jaydev Desai** (ME) and Associate Research Scientist **Cornelia Fermuller** (UMIACS) are teaming with Assistant Professor **Kelly Westlake** (Physical Therapy) of the University of Maryland Baltimore School of Medicine.

Their project, "A robotic grasping and vision system for stroke rehabilitation," will develop a camera-assisted, portable, robotic exoskeleton with a custom-designed glove and active-assisted hand flexion and extension capability (GraspVis) to assist and improve affected hand function after strokes. GraspVis will modulate the amount of force needed for grasping based on user force feedback. It is the first lightweight, portable device to allow multi-joint motion of the hand.

Today, most therapies aimed at specifically reversing motor impairments due to stroke fall short. Key principles of motor learning and associated brain plasticity support repetitive, task-specific practice to reduce impairment and restore function. The GraspVis system will address these needs.

Michael Rotkowitz wins NSF CAREER Award

Assistant Professor **Michael Rotkowitz** (ECE/ISR) has won a 2014 National Science Foundation Faculty Early Career Development (CAREER) Award for "Decentralization and Parsimony for Implementable Control of Massively Interconnected Systems." The five-year award is worth $400,000.

The advent of complex interconnected systems has created a need to design and analyze controllers that can observe information from a small portion but affect a large portion of the network. This includes smart building management, multi-vehicle systems and convoys, irrigation networks, large array telescopes, and the power distribution grid.

Developing these controllers is a challenge for cyber-physical systems. Conventional controls analysis assumes a *centralized* decisionmaker can access all available measurements and determine the usage of all possible means of actuation. Most design and analysis methods are extremely fragile to this assumption, and break down when such centralization is not possible or desired.

There is an enormous disconnect in decentralized control between celebrated theoretical advances and the concepts that are used for implementation or computation. This is true of both recent advances and more classical results.

Rotkowitz's project pursues the reasons for this disconnect, along with other impending barriers to the systematic implementation of decentralized control theory, particularly those which will become disabling when applied to massive systems. It will broaden the applicability of elegant and useful aspects of optimization theory and estimation, which have the potential to be used broadly and to affect many other fields.

Balan receives NSF grant for optimizing sensor arrays

ISR-affiliated Professor **Radu Balan** (Math) is the principal investigator on an NSF I-Corps grant for "Optimizing Sensor Arrays for Waveform Enhancement."

Balan will build an optimized, large-scale microphone array that allows spatial audio selection. This system will focus in on a target source while suppressing interferences from a wide variety of locations. It will allow users to listen in on a selected target source even when it is surrounded by interfering sources that both move and outnumber the number of sensors. The system will process acoustic and electromagnetic waveforms to discover both the number and location of sources in these multi-path, noisy environments, then separate each source by either cancelling or attenuating interferences and identifying previously recognized sources. The technology will optimize sensor placement and processing using state-of-the-art optimization and statistical modeling techniques.

Rubloff, Hu win NSF grant for graphene ink techniques

Assistant Professor **Liangbing Hu** (MSE) and Professor **Gary Rubloff** (MSE/ISR) have won an NSF grant to develop a new manufacturing technique for electronic displays and solar cells. Manufacturers want to print electronic circuit sheets using graphene ink, but need to electronically connect graphene particles to each other. Hu and Rubloff will "nano-glue" graphene flakes together after they are laid down using atomic layer deposition. Their technique also will correct defects in the material—a major problem for nano manufacturing because defects are much too tiny to spot. Hu focuses on roll-to-roll printing and film characterizations, while Rubloff is working on selective ALD and defect characterizations.

Flatau to study rare-earth-free materials

ISR-affiliated Professor **Alison Flatau** (AE) is the principal investigator for an NSF grant, "The Role of Surface-Energy on Texture Development in Rare-Earth-Free Auxetic and Magnetostrictive Materials."

This research will improve the performance capabilities of costly single-crystal alloys in low-cost polycrystalline alloys. Models of atomic structure and energy-based models of crystal growth processes will be used to gain insights into how to control and target the selective growth of desired crystals at the expense of crystals with less favorable mechanical and magnetostrictive properties.

The iron-aluminum and iron-gallium alloys in this research are good candidates for a sustainable alternative to rare-earth elements like terbium and dysprosium used in industrial and defense applications. They are earth-abundant, inexpensive and benign.

Min Wu explores power network fingerprints for information forensics

ISR-affiliated Professor **Min Wu's** (ECE/UMIACS) project, "Exploring Power Network Attributes for Information Forensics," is funded by an NSF Secure and Trustworthy Cyberspace grant.

Wu is exploiting novel intrinsic fingerprints in the environment to investigate scientific and technological foundations of time, location and integrity of sensor recordings.

Such fingerprints include the small, random-like fluctuations of electric network frequency. They reflect power grid attributes and conditions and become naturally "embedded" into video, audio or other types of sensor signals at the time of recording. The fluctuations carry time and location information and may facilitate integrity verification of the primary sensing data.

Learning more about these fingerprints will have important applications in crime solving, counterterrorism, journalism, infrastructure monitoring, smart grid management, and other commercial operations.

Bruck, Smela, Yu: compliant robotic structures

Professor **Hugh Bruck** (ME), Professor **Elisabeth Smela** (ME/ISR) and ISR-affiliated Associate Professor **Miao Yu** (ME) have received an NSF National Robotics Initiative award for "Compliant Multifunctional Robotic Structures for Safety and Communication by Touch." The researchers are developing a robotic system

similar to the human nervous system, based on arrays of conducting polymers. This sensor array will be able to sense shape and force distributions.

The research will enable robots to physically communicate in a way similar to human touch. It also will make possible new bio-inspired control principles for training robots. Enhancing robots' ability to distinguish humans from other objects in their environment will significantly advance robotic safety and decisionmaking, and create possibilities for new multifunctional robots in critical fields such as health care.

Marcus, Fu conducting optimization research

Professor **Steve Marcus** (ECE/ISR) and Professor **Michael Fu** (BGMT/ISR) have received an NSF Operations Research grant, "A New Approach to Nonconvex Risk-Sensitive Stochastic Optimization."

The researchers will develop a framework for incorporating risk into sequential decision making under uncertainty, using cumulative prospect theory and dynamic risk measures. They will formulate a single theory that integrates subjective preferences in human behavior with normative decision-making objectives. The framework will develop efficient dynamic programming sampling and simulation-based methods for risk-sensitive optimization and control problems, and investigate how modeling risk-sensitivity affects the behavior of decision makers. Algorithms will address practical decisionmaking problems in manufacturing and supply chain management, health care service systems, transportation and financial engineering.

Narayan is PI for NSF sampling rate distortion grant

Professor **Prakash Narayan** (ECE/ISR) is the principal investigator for an NSF Communication and Information Theory grant, "Sampling Rate Distortion."

The research aims to understand principles that govern a coordinated rate-efficient sampling of multiple signals and centralized compression of the sampled subset. The goal is to reconstruct the entirety of the signals within acceptable distortion levels. Narayan hopes to characterize fundamental performance limits of optimum sampling rate and lossy compression rate and their interplay, together with the best choice of sampling mechanisms and attendant processing for reconstruction.

He will develop a principle of "sampling rate distortion" which lies at the intersection of information theory and signal processing, and has the larger objective of elucidating material connections between sampling and rate distortion performance. Potential applications include dynamic thermal management for on-chip temperature control during runtime; network function computation; and image restoration, surface reconstruction and visual integration in computer vision.

Srivastava to develop microfluidic cooling technology

Professor **Ankur Srivastava** (ECE/ISR) is the principal investigator of an NSF grant to develop and refine microfluidic 3D IC cooling technology. The grant also includes Georgia Tech investigators Muhannad Bakir and Yogi Joshi. Thermal issues in 3D ICs are challenging because of their high device densities. Srivastava is exploring interlayer micro-fluidic cooling technology for heat removal. This enables the level of cooling in different areas of the chip to be controlled, which could lead to improved performance and energy efficiency.

Ulukus researching incentive compatible wireless security

Professor **Sennur Ulukus** (ECE/ISR) has won an NSF grant for "Incentive Compatible Wireless Security." Along with Penn State's Aylin Yener and Randall Berry from Northwestern University, she is creating a practical setup for wireless security by amalgamating information theory with the theory of incentives. Among other things, the team will develop mechanisms to incentivize non-altruistic cognitive nodes to participate in information theoretic security protocols as well as incentive mechanisms for scenarios where all nodes have equal access to spectrum and need confidentiality, even from each other.

Khaligh developing wind energy power conditioning

Assistant Professor **Alireza Khaligh** (ECE/ISR) and Bethesda-based Altenera Technology have received a Maryland Industrial Partnerships (MIPS) award to develop a power conditioning system for the company's mobile, lightweight wind harvester panel. This panel runs quietly, has no spinning parts and performs well under many wind conditions. The award is part of Round 52 of funding for the MIPS program, an initiative of the Maryland Technology Enterprise Institute (Mtech).

Khaligh, Tits, McCluskey receive NSF GOALI grant for hybrid energy storage systems

GENOVATION'S G2 PLUG-IN HYBRID ELECTRIC VEHICLE

Assistant Professor **Alireza Khaligh** (ECE/ISR), Professor **André Tits** (ECE/ISR), and Associate Professor **Patrick McCluskey** (ME/CALCE) have received an NSF Grant Opportunities for Academic Liaisons with Industry award for "Advanced Silicon Carbide-Based Novel Hybrid Energy Storage System for Plug-In Electric Vehicles." They will work with Steven Rogers, co-founder, president and chief technology officer of Genovation, a company developing the G2 plug-in hybrid electric automobile.

The researchers will develop a novel hybrid energy storage system for electric vehicles. The new system will be composed of a high energy-density battery pack, an ultracapacitor pack and a DC/DC converter. This new lightweight system will weigh less than a conventional high power-density battery pack alone and offer an increased battery lifetime.

Fellows

Professor **John Baras** (ECE/ISR) has been named a Fellow of the Society for Industrial and Applied Mathematics (SIAM). Baras was recognized for his "contributions to systems theory, stochastic control and communication networks." He is also a Fellow of the Institute of Electrical and Electronics Engineers (1984) and the Royal Swedish Academy of Engineering Science (2006).

ISR-affiliated Professor **Peter Sandborn** (ME) has been elected a fellow of the American Society of Mechanical Engineers (ASME). Sandborn was recognized for his contributions in the life-cycle cost modeling for systems field that "have been particularly instrumental in refocusing significant portions of the systems community to include a view of the system life cycle within their design and strategic planning activities." He is the director of the Maryland Technology Enterprise Institute.

The Association for Computing Machinery (ACM) named Professor **Dana Nau** (CS/ISR) a Fellow "for contributions to automated search and planning." Nau also is a Fellow of the American Association for Artificial Intelligence (AAAI).

Invited speaker

Ghodssi invited speaker at IEEE Sensors Conference

ISR Director **Reza Ghodssi** (ECE/ISR) was an invited speaker at the IEEE Sensors 2013 in Baltimore. Ghodssi spoke on "Microsystems for Sensing and Characterization of Bacterial Biofilms." Bacterial biofilms cause severe infections in people and contamination problems in environmental facilities due to their complex bacterial composition and extracellular matrix. Ghodssi discussed the fundamental mechanisms of biofilm formation, and explained that non-invasive characterization is desirable. Biofilm sensing at an early stage of growth is critical for managing associated problems, such as infectious diseases.

Major publications

Rubloff, Ghodssi featured in *JVST-A* special issue

Articles by Maryland Nanocenter Director **Gary Rubloff** (MSE/ISR) and ISR Director **Reza Ghodssi** (ECE/ISR) were recently featured in a special issue of the *Journal of Vacuum Science & Technology A*. The issue, an eclectic collection of 26 reviewing articles and three perspective articles exploring the society's past and imagining the future, commemorated the 60th anniversary of the American Vacuum Society (AVS).

Rubloff, along with **Alexander C. Kozen** and **Sang Bok Lee**, wrote a perspective article, "From nanoscience to solutions in electrochemical energy storage." Ghodssi, along with **Xiao Z. Fan, Ekaterina Pomerantseva, Markus Gnerlich, Adam Brown, Konstantinos Gerasopoulos, Matthew McCarthy** and **James Culver,** wrote a reviewing article, "Tobacco mosaic virus: A biological building block for micro/nano/bio systems."

The front cover of the special issue features 10 images that encompass the scope of research covered by scientists in the AVS. Of the 10, three of the images come from Gary Rubloff's research group and another was supplied by Reza Ghodssi's group.

Interdisciplinary researchers explain 'third party' evolution

You're shopping for holiday gifts in a department store when you spot someone pocketing a nice pair of leather gloves. What do you do?

A study by ISR researchers in the *Proceedings of the Royal Society B* predicts that whether you alert a manager to the theft or decide to do nothing may depend on whether you're shopping in a local store where you know the owners or in a city far from home. The research was conducted by Professor **Dana Nau** (CS/ISR), Professor **Michele Gelfand** (Psychology), and two of Nau's former students, alumnus and Postdoctoral Researcher **Patrick Roos** (CS Ph.D. 2012) and alumnus **Ryan Carr** (CS Ph.D. 2012).

The article, "High strength-of-ties and low mobility enable the evolution of third-party punishment," suggests that the stronger a community's social ties and the longer most people stay within the community, the more likely it is that otherwise uninvolved third parties will step forward to punish their neighbors.

Simon and Ding publish speech envelope research in *NeuroImage*

Professor **Jonathan Simon** (ECE/Biology/ISR), his former student **Nai Ding** (EE Ph.D. 2012), and co-author **Monita Chatterjee** of Boys Town National Research Hospital published "Robust Cortical Entrainment to the Speech Envelope" in the March 2014 issue of *NeuroImage*. Ding is the primary author.

The team examined how brains extract and process speech that is acoustically disrupted by noise, as heard by a cochlear implant user. They found that the brain can cleanly extract speech, as long as there is no surrounding noise. But even moderate noise severely disrupts the brain's ability to extract the speech under cochlear implant listening conditions.

Kanold and Lee: Darkness may heal hearing woes

ISR-affiliated Associate Professor **Patrick Kanold** (Biology) is one of two authors of a paper that received national attention after it was published in the Feb. 5 issue of the journal *Neuron*. Kanold's research, "Crossmodal Induction of Thalamocortical Potentiation Leads to Enhanced Information Processing in the Auditory Cortex," may someday lead to treatments for people with hearing loss or tinnitus. Kanold's co-author is **Hey-Kyoung Lee,** an associate professor of neuroscience at Johns Hopkins University.

We often hear of a young child who is blind developing a keen ability to hear things others cannot. Researchers have known this

can happen in the brains of the very young, which are malleable enough to re-wire some circuits that process sensory information. Kanold and Lee's research holds promise that this effect can also happen after childhood. Their study shows the brains of adult mice can be re-wired, compensating for a temporary vision loss by improving their hearing.

"We are revealing a level of interconnectedness of the senses in the brain," Kanold said.

There is an early "critical period" for hearing, similar to the better-known critical period for vision. The auditory system in the brain of a very young child quickly learns its way around its sound environment, becoming most sensitive to the sounds it encounters most often. But once that critical period is past, the auditory system doesn't respond to changes in the individual's soundscape.

Kanold and Lee thought the adult brain might be flexible if it were forced to work across the senses rather than within one sense. They used a simple, reversible technique to simulate blindness: they placed adult mice with normal vision and hearing in complete darkness for six to eight days.

After the adult mice were returned to a normal light-dark cycle, their vision was unchanged. But they heard much better than before.

The fact that the changes occurred in the cortex of the brain, an advanced sensory processing center structured about the same way in most mammals, suggests that flexibility across the senses is a fundamental trait of mammals' brains.

Yin, Fritz, Shamma publish neuroplasticity study

"Rapid Spectrotemporal Receptive Field Plasticity in Primary Auditory Cortex During Behavior" by ISR Postdoctoral Researcher **Pingbo Yin**, ISR Associate Research Scientist **Jonathan Fritz,** and Professor **Shihab Shamma** (ECE/ISR) has been published in the *Journal of Neuroscience.* The research shows that induced patterns of rapid changes in neural pathways and synapses in the brain closely reflect the time and frequency of the tasks being performed. The study extends the functional relevance of rapid task-related brain changes to perceiving and learning natural sounds such as vocalizations in animals and speech in humans.

Complex natural and environmental sounds, such as speech and music, convey information along both frequency and time. The way the brain represents such stimuli rapidly adapts when animals become actively engaged in discriminating them. The study examined the nature of these changes.

UMD neuroscience researchers publish in *Neuron*

"Emergent Selectivity for Task-Relevant Stimuli in Higher-Order Auditory Cortex," by Professor **Shihab Shamma** (ECE/ISR), ISR Associate Research Scientist **Jonathan Fritz** and their colleagues has been published in the journal *Neuron*. It suggests the brain's auditory, visual and somatosensory systems may have a similar functional hierarchical structure.

Co-first authors on the paper are alumna **Serin Atiani** (NACS Ph.D. 2010), a former student of Shamma and currently a postdoctoral researcher at the Montreal Neurological Institute, McGill University, Montreal; and former ISR postdoctoral researcher **Stephen David,** an assistant professor at Oregon Health & Science University.

Other authors include **Diego Elgueda**, a graduate student in the Neuroscience and Cognitive Sciences program, co-advised by Shamma and Fritz; Electrical and Computer Engineering Ph.D. student **Michael Locastro**, advised by Shamma; and **Susanne Radtke-Schuller** of Ludwig Maximilians University, Munich, Germany.

While attention-related effects have been demonstrated in the mammalian brain's primary auditory cortex, an understanding of the functional role of higher auditory cortical areas in guiding attention to acoustic stimuli has been elusive. The researchers showed that changes in neuronal firing rates and response dynamics greatly enhanced responses to target stimuli relative to distractors, allowing for greater attentional selection during active listening. This suggests a general mechanism by which top-down control circuits could extract behaviorally relevant sensory features through a hierarchy of brain areas.

Best paper awards

ICAPS best paper award for Nau, Shivashankar and colleagues

"Optimal Planning with Global Numerical State Constraints" won the Outstanding Student Paper Award at the 2014 International Conference on Automated Planning and Scheduling. The paper was written by Computer Science Ph.D. student **Vikas Shivashankar,** Professor **Dana Nau** (CS/ISR) and Franc Ivankovic, Patrik Haslum and Sylvie Thiebaux, of the Optimisation Research Group, NICTA (Australia Information Communications Technology Research Centre of Excellence) and the Research School of Computer Science at Australia National University. ICAPS is the premier conference for AI planning research.

The research addresses automating the operations of infrastructure networks such as energy grids and oil pipelines, which require a range of planning and optimization technologies.

Shneiderman, Plaisant win AMIA Distinguished Paper Award

ISR-affiliated Professor **Ben Shneiderman** (CS/UMIACS) and HCIL Director of Research **Catherine Plaisant** (UMIACS) and their research team received a Distinguished Paper Award at the American Medical Informatics Association Annual Symposium.

The team won for their paper, "Twinlist: Novel User Interface Designs for Medication Reconciliation." The award was given to only five full-length research papers out of more than 330 papers submitted to the conference.

Twinlist is an interface for medication reconciliation that alleviates the tediousness of manual reconciliation without diminishing a clinician's decisionmaking ability. The paper described efforts to refine Twinlist, including staged animations and spatial layouts that enable users to perform medication reconciliation.

Khaligh wins Best Vehicular Electronics Paper Award

A paper by Assistant Professor **Alireza Khaligh** (ECE/ISR) published in *IEEE Transactions on Vehicular Technology* received the Best Vehicular Electronics Paper Award from the IEEE Vehicular Technology Society.

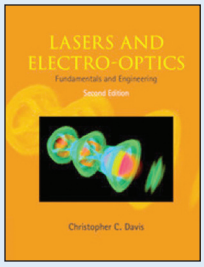
"Battery, Ultracapacitor, Fuel Cell and Hybrid Energy Storage Systems for Electric, Hybrid Electric, Fuel Cell and Plug–In Hybrid Electric Vehicles" was co-written by Khaligh and his former student at the Illinois Institute of Technology, **Li Zhihao.**

The article appeared in the journal's July 2010 issue. Zhihao is now an electrical engineer at the GE Global Research Center.

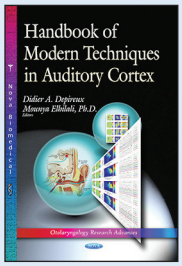
This is the second time Khaligh has won the award.

Khaligh also has been named an associate editor of *IEEE Transactions on Transportation Electrification* and has been appointed a distinguished lecturer for the IEEE Vehicular Technology Society for the next two years. He will deliver lectures at VTS chapter meetings on power electronics in transportation electrification, mainly on electric vehicles and plug-in hybrid electric vehicles.

Books



The second edition of ISR-affiliated Professor **Christopher Davis'** (ECE) book, *Lasers and Electro-Optics* has been published by Cambridge University Press. The textbook covers a broad range of topics in modern optical physics and engineering, and gives a detailed introduction to the basic physics and engineering of lasers. It covers the design and operational principles of a wide range of optical systems and electro-optic devices.



ISR Associate Research Scientist **Didier Depireux** and alumna and former ISR post-doctoral researcher **Mounya Elhilali** (EE Ph.D. 2004) are co-editors of *Handbook of Modern Techniques in Auditory Cortex*. Elhilali, a former student of Professor **Shihab Shamma** (ECE/ISR), is an assistant professor in Electrical and Computer Engineering at Johns Hopkins University.

The book is part of the Otolaryngology Research Advances series produced by Nova Science Publications, Inc. It addresses the host of new techniques, called "broadband methods," that recently have been developed for the study and modeling of the auditory pathway. The book is the first to present, in a single volume, different broadband methods, their philosophies, their relative advantages and disadvantages, and a methodology that will help practitioners get started, navigate the literature, and chose the most appropriate method.

Patent

Professor **Tony Ephremides** (ECE/ISR) and his former student, alumna **Beiyu Rong** (ECE Ph.D. 2010) have been awarded US Patent 8,542,579 for "Method and System for Cooperative Transmission in Wireless Multi-Hop Networks." Their invention addresses user cooperation in wireless networks implemented on the network protocol layer level, and attains a higher stable throughput and improved transmission delay.

University of Maryland awards

Ghodssi named Distinguished Scholar-Teacher

ISR Director **Reza Ghodssi** (ECE/ISR) has been selected as a 2014-2015 Distinguished Scholar-Teacher by the University of Maryland. Ghodssi is the Herbert Rabin Distinguished Chair in Engineering. He joins Professor **Min Wu** (ECE/UMIACS), Professor **Carol Espy-Wilson** (ECE/ISR), Professor **Avis Cohen** (Biology/ISR), Professor **K. J. Ray Liu** (ECE), Professor **Michael Fu** (Robert H. Smith School of Business/ISR), Professor **Steve Marcus** (ECE/ISR), and Professor Emeritus **Thomas McAvoy** (ChBE/BioE/ISR), as ISR winners of the award.

The Distinguished Scholar-Teacher program recognizes faculty members who have demonstrated outstanding scholarly achievement along with equally outstanding accomplishments as teachers. Scholar-Teachers bring a passion for learning to their colleagues and students, and serve as models of what a professor at a fine research university should be. As part of the program, Ghodssi will make a public presentation on a topic of scholarly interest.

White receives junior faculty award

ISR-affiliated Associate Professor **Ian White** (BioE) has received the Clark School of Engineering's E. Robert Kent Outstanding Teaching Award for Junior Faculty. White received the award for "[his] innovations in education, his ratings and reviews in both undergraduate and graduate classes, as well as his work with local high schools... and mentor[ship of] teams of high school teachers."

BioE Chair William Bentley says White has "consistently demonstrated a strong commitment to excellence in education" both inside and outside the classroom, in outreach, and as a mentor to senior Capstone Design teams.

Paley awarded Willis H. Young Jr. Faculty Fellowship

Associate Professor Derek Paley (AE/ISR) has been given the Willis H. Young Jr. Faculty Fellowship and appointed him to a three-year term as the Willis H. Young Jr. Professor of Aerospace Engineering Education. The fellowship is awarded to a tenured faculty member in aerospace engineering with outstanding contributions to undergraduate and graduate education.

Promotions

University of Maryland President Wallace Loh has approved the promotion of five ISR faculty members. **Gang Qu** (ECE/ISR), **Ankur Srivastava** (ECE/ISR), and **Jonathan Simon** (ECE/Biology/ISR) have been promoted to full professor. **Sarah Bergbreiter** (ME/ISR) and ISR-affiliated **Ian White** (BioE) received tenure and have been promoted to associate professor.

Editorships

Gabriel named to two associate editor positions

ISR-affiliated Professor **Steven Gabriel** (CEE) was recently named associate editor at *Optimization and Engineering* (Springer) and associate editor for *Energy Strategy Reviews* (Elsevier). Gabriel is also area editor for *Energy at Networks and Spatial Economics* (Springer) and is on the editorial board of *ASCE Journal of Energy Engineering.* Gabriel is a well-known expert on energy market equilibrium models and optimization models and theory.

Srivastava joins *IEEE Transactions on Computer-Aided Design*

Professor **Ankur Srivastava** (ECE/ISR) has been named the associate editor of *IEEE Transactions on Computer-Aided Design (CAD)* in modeling, simulation and validation. The publication features articles on

methods, algorithms, and human-machine interfaces for physical and logical design, including planning, synthesis, partitioning, modeling, simulation, layout, verification, testing, and documentation of integrated-circuit and systems designs of all complexities.

Advisory board

Adomaitis is U.S. representative to Euro/CVD board

Professor **Raymond Adomaitis** (ChBE/ISR) has been selected as the U.S. representative to the International Advisory Board of the EuroCVD conferences.

This biennial series in the chemical vapor deposition (CVD) field is considered one of the preeminent international thin-film conferences, bringing together leading CVD researchers from academic and industrial laboratories. Adomaitis will be involved in planning the 2015 meeting.

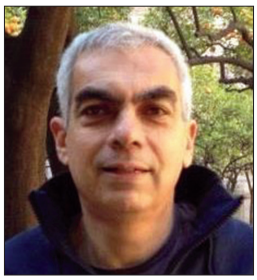
New ISR faculty

ISR welcomed two new affiliate faculty who are assistant professors in the Department of Electrical and Computer Engineering this summer.

Behtash Babadi earned a Ph.D. in Engineering Sciences from Harvard University in 2011 and was a postdoctoral fellow in the Department of Brain and Cognitive Sciences at the Massachusetts Institute of Technology and in the Department of Anesthesia, Critical Care and Pain Medicine at Massachusetts General Hospital. His research interests are in statistical and adaptive signal processing, neural signal processing and systems neuroscience.

Piya Pal earned her Ph.D. in Electrical Engineering from the California Institute of Technology in 2013. Her research interests are in compressive and structured sampling, statistical signal processing with applications in radar and array processing, tensor methods, and statistical learning.

Alum Amnon Lotem wins Gödel Prize



Alumnus **Amnon Lotem** (CS Ph.D. 2000) and co-authors Ronald Fagin (IBM Research—Almaden) and Moni Naor (Weizmann Institute of Science) have been honored with the 2014 Gödel Prize for their paper, "Optimal Aggregation Algorithms for Middleware." Lotem was advised at Maryland by Professor **Dana Nau** (CS/ISR).

The Gödel Prize recognizes outstanding papers in theoretical computer science and is presented by the European Association for Theoretical Computer Science (EATCS) and the Association for Computing Machinery's Special Interest Group on Algorithms and Computation Theory.

The paper introduced the powerful "threshold algorithm" widely used in applications and systems that demand optimal results for gathering multi-sourced information. It provides a framework to design and analyze algorithms where aggregation of information from multiple data sources is needed, such as in information retrieval and machine learning. The threshold algorithm's elegant mathematical properties and simplicity are particularly suitable for middleware, software often used to augment computer operating systems that support complex, distributed applications. The paper also introduced the idea of instance optimality, an extremely strong guarantee of performance, and showed that the threshold algorithm is instance optimal. The groundbreaking results built a foundation for much further research.

Lotem first started pursuing the ideas as a Maryland student in a course on databases, where he examined an idea for improving the existing "Fagin's algorithm" in data aggregation. Lotem created an optimal algorithm for the defined problem, and he and his instructor, Mike Franklin, subsequently co-wrote a paper on the subject.

Today Lotem is chief data scientist with Seculert. The prize was awarded in July at the 41st International Colloquium on Automata, Languages, and Programming in Copenhagen.

Alumna Kirsten Bohn's bat song research is *Science* cover story

KIRSTEN BOHN SETS UP MONITORING EQUIPMENT IN THE UXMAL RUINS.

University of Maryland alumna **Kirsten "Kisi" Bohn's** (Biology Ph.D. 2005) research was the subject of "When the bat sings," the cover story of the June 20, 2014 issue of *Science*.

The story follows Bohn as she studies the songs of bats roosting in ruins in Uxmal, Mexico. The songs are different from bats' more simple high-frequency chirps used in echolocation or social calls. These sounds are more complex and rhythmic, like those sung by birds, whales... and humans. Bohn seeks to understand the social and environmental conditions that explain why bats sing—a mentally demanding behavior that few mammals attempt.

Studies by Bohn and others have found that like birds, bats that sing tend to be male, live in societies where males mate with more than one female and sing during mating season to court females and defend territories. The hope is that the bat studies can help explain the overall evolution of complex vocal abilities, including, eventually, human speech.

At Maryland, Bohn was co-advised by Professor **Cynthia Moss** (Psychology/ISR, now at Johns Hopkins University) and Professor **Gerald Wilkinson** (Biology). Currently she is a research assistant professor at Florida International University in Miami, where her Bat Communication Lab focuses on the evolution of vocal complexity by studying several different species of *molossidae* free-tailed bats.

Liu, Han, Trappe named IEEE Fellows

Alumna **Mingyan Liu,** professor in the Electrical Engineering and Computer Science Department at the University of Michigan, has been named a 2014 Fellow of the Institute of Electrical and Electronics Engineers (IEEE) "for contributions to modeling of wireless ad-hoc and sensor networks."

Liu received her M.S. in Systems Engineering degree in 1997 and her Ph.D. in Electrical Engineering in 2000. She was advised by Professor **John Baras** (ECE/ISR) for both degrees. Liu's research interests are in resource allocation, performance analysis, and energy-efficient design of wireless, mobile ad-hoc, and sensor networks.

Alumnus **Zhu Han**, an associate professor in the Electrical and Computer Engineering Department at the University of Houston, has been named an IEEE Fellow, "for contributions to resource allocation and security in wireless communications."

Han, a 2003 EE Ph.D. advised by Professor **K.J. Ray Liu** (ECE), manages the Wireless Networking, Signal Processing and Security Lab. His research interests include wireless resource allocation and management, wireless communications and networking, game theory, wireless multimedia, and security. Han is an 2010 NSF CAREER award recipient. He is also the winner of the 2011 IEEE Communications Society Fred W. Ellersick Prize and has won several best paper awards.

Alumnus **Wade Trappe,** a professor in the Electrical and Computer Engineering

Department at Rutgers University, and associate director of its Wireless Information Network Lab (WINLAB), has been named an IEEE Fellow "for contributions to information and communication security."

At Maryland, Trappe earned a Ph.D. in applied mathematics and scientific computing in 2002; he was affiliated with both ISR and the Electrical and Computer Engineering Department, and was advised by Professor **K.J. Ray Liu** (ECE). He has become a nationally recognized authority in wireless network security.

Manikonda named IAI president and CEO

Alumnus **Vikram Manikonda** (EE Ph.D. 1997) has been appointed president and chief executive officer of Intelligent Automation, Inc. (IAI), Rockville, Md. He is a former advisee of Professor **P. S. Krishnaprasad** (ECE/ISR).

Manikonda joined IAI in 1999. At Maryland, he helped develop MDLe, a motion control language for robotics, and was manager of the Intelligent Servosystems Laboratory. IAI is an ISR Associate Partner.

Andres Kwasinski earns tenure at RIT

Alumnus **Andres Kwasinski** (EE Ph.D. 2004) recently received tenure at the Rochester Institute of Technology and has been promoted to associate professor in the Department of Computer Engineering.

Kwasinski's research interests are in digital signal processing and wireless communications and networking. At Maryland, he was advised by **Nariman Farvardin** (ECE/ISR), now the president of the Stevens Institute of Technology in Hoboken, N.J. He also was a postdoctoral researcher with Professor **K.J. Ray Liu** (ECE).

Rakesh Nagi named UIUC department chair

Alumnus **Rakesh Nagi** (ME Ph.D. 1991) has been named the Donald Biggar Willett Professor and Chair of the Department of Industrial & Enterprise Systems Engineering at the University of Illinois Urbana-Champaign (UIUC).

Nagi joined UIUC from SUNY-Buffalo, where he had been on the faculty since 1993. He served as the chair of Industrial and Systems Engineering there from 2006 to 2012. Nagi also was a research associate at France's National Institute for Research in Computer Science and Control (INRIA).

Nagi is an expert in using location theory to improve production systems, information-based manufacturing, and military applications of operations research. He is a Fellow of the Institute of Industrial Engineers.

At Maryland, Nagi was advised by the late Professor **George Harhalakis** (ME/ISR). He won the ISR Outstanding Systems Engineering Graduate Student Award in 1991.

ISR alumni!

Do you have career news? Have you recently moved?

We want to stay in touch with you and we'd love to share your news with our readers, both in print and online.

Send your news and contact information updates to Rebecca Copeland at rebeccac@umd.edu.

ECE Dissertation Fellows

ISR-related Ph.D. students were given all five of the Electrical and Computer Engineering Department's annual dissertation fellowships.

Anup Menon (EE Ph.D. 2014) was advised by Professor **John Baras** (ECE/ISR). His dissertation, "Learning in Multi-Agent Engineered Systems," was focused on developing provably correct multi-agent learning algorithms and understanding the effects of the information exchange network on decentralized control systems. Menon also won a 2014 Kulkarni Foundation Summer Research Fellowship, which supports UMD doctoral students who are graduates of the Indian Institute of Technology, and was one of four student finalists for the best paper award at the 2013 IEEE Conference on Decision and Control for "A Distributed Learning Algorithm with Bit-valued Communications for Multi-agent Welfare Optimization."

Young Wook Kim (EE Ph.D. 2014) was advised by ISR Director **Reza Ghodssi** (ECE/ISR). His dissertation was focused on developing an integrated microsystem for in-vivo biofilm detection and treatment, and his research interests are in clinical diagnostic tool development, bacterial biofilms, wireless implantable microsystem, biosensors and biofilm treatments.

Haoyu Wang (EE Ph.D. 2014) was advised by Assistant Professor **Alireza Khaligh** (ECE/ISR). His dissertation topic was "Ultra-Compact and Highly Efficient Wide Band Gap Based Power Electronics Interfaces for Plug-In Hybrid Electric Vehicles."

Caleb Serafy is advised by Professor **Ankur Srivastava** (ECE/ISR). His dissertation is "Electro-Thermal-Fluidic Co-Design for Performance and Resilience in 3D Integrated Circuits," and his research interests are in overcoming the design challenges associated with 3D-IC design.

Omur Ozel is advised by Professor **Sennur Ulukus** (ECE/ISR). His dissertation topic is "Coding and Scheduling in Energy Harvesting Communication Systems." His research interests are in wireless communications and information theory and physical layer security.

James Jones wins WINFORMS Award

James Jones, a Civil and Environmental Engineering Ph.D. student in the Civil Systems program, has won the 2014 WINFORMS Student Excellence Award in Operations Research. WINFORMS is the Washington, D.C. chapter of INFORMS, the Institute for Operations Research and the Management Sciences. He is advised by Associate Professor **David Lovell** (CEE/ISR).

Jones won the competition for his presentation on managing terminal airspace demand uncertainty with en-route speed control. His research is conducted within NEXTOR, the FAA Consortium in Aviation Operations Research, and his research interests are in algorithms for air traffic management. Jones received a research stipend from the FAA's Graduate Research Award Program on Public-Sector Aviation Issues during the 2012-2013 academic year.

Presacco, Heffner, Smith representing Maryland at Universitas 21

This summer Ph.D. students **Alessandro "Alex" Presacco** (NACS), **Christopher Heffner** (NACS) and **Theresa Smith** (Kinesiology) represented the University of Maryland at the Universitas 21 Graduate Research Conference 2014: Celebrating Ageing Research, in Auckland, New Zealand.

Presacco is co-advised by Professor **Jonathan Simon** (ECE/Biology/ISR) and Assistant Professor **Samira Anderson** (Hearing & Speech Sciences). He will report on the preliminary findings from Anderson and Simon's ADVANCE seed grant, "Effects of Aging on Speech in Noise Processing in the Auditory Cortex and Midbrain."

A travel fellowship from the University of Maryland Graduate School is making possible the trio's appearance at the conference. Maryland is a new member of Universitas 21 (U21), a global network of 27 research-intensive universities that work together to foster global citizenship and institutional innovation through research-inspired teaching and learning, student mobility, connecting students and staff, and wider advocacy for internationalization.

Datta, Subramanian earn All-S.T.A.R. Fellowships

ECE Ph.D. candidates **Timir Datta** and **Sowmya Subramanian** are university-wide winners of the Graduate All-S.T.A.R. Fellowships, given by the University of Maryland Graduate School. The competitive fellowships are intended to honor graduate students who are both outstanding scholars and outstanding graduate assistants.

Datta is a research assistant co-advised by Associate Professor **Pamela Abshire** (ECE/ISR) and Professor **Elisabeth Smela** (ME/ISR). He is a Future Faculty Fellow and has been an integral contributor to three invention disclosures submitted to the Office of Technology Commercialization. His doctoral research is on the development of a hybrid living and electronic nose.

Subramanian is a research assistant and a R.W. Deutsch fellow advised by ISR Director **Reza Ghodssi** (ECE/ISR). Subramanian also is a Future Faculty Fellow who has presented her work at many conferences and was awarded the Best Student Poster Award at the 2014 Mid-Atlantic Micro/Nano Alliance Symposium.

Barnes receives National Academies research stipend

Xenia Barnes, a student in ISR's MSSE degree program, has received a $10K research stipend from the Transportation Research Board of the National Academies.

The Graduate Research Award Program on Public-Sector Aviation Issues is sponsored by the Federal Aviation Administration and administered by the Airport Cooperative Research Program (ACRP) of the Transportation Research Board/National Academies.

Barnes works on projects associated with the National Center of Excellence for Aviation Operations Research (NEXTOR) and is advised by Professor **Michael Ball** (BGMT/ISR) and Associate Professor **David Lovell** (ME/ISR).

Gupta group wins three awards at ASME IDETC/CIE

Professor **S.K. Gupta** (ME/ISR), his alumni and students won three awards at the

2013 ASME Computers and Information in Engineering Conference.

Gupta received the ASME Computers and Information in Engineering Division's Excellence in Research Award.

Gupta, his postdoctoral researcher **Krishna Kaipa,** Mechanical Engineering Ph.D. student **Carlos Morato** and **B. Zhao** received the Computer Aided Product and Process Development Technical Committee's 2013 Prakash Krishnaswami Best Paper Award for "Safe human robot interaction by using exteroceptive sensing based human modeling."

Alumnus **Atul Thakur** (ME Ph.D. 2011), an assistant professor at the Indian Institute of Technology Patna, received the ASME Computers and Information in Engineering Division's 2013 Best Dissertation Award. "Physics-Aware Model Simplification for Interactive Virtual Environments," presents computational methods for improving the speed of rigid body simulations 40 times faster than existing techniques. Takur was advised by Gupta.

Future Faculty

Three ISR graduate students have been named to the Clark School's Future Faculty Fellows program. **Sahar Akram**, a student in the Neural Systems Lab, is advised by Professor **Shihab Shamma** (ECE/ISR), and studies underlying mechanisms of sound streaming in the brain.

James Ferlez is a student in Thermal, Fluid, and Energy Sciences, advised by Professor **Steve Marcus** (ECE/ISR).

Sowmya Subramanian is a student in the MEMS Sensors and Actuators Lab advised by ISR Director **Reza Ghodssi** (ECE/ISR).

The program was created in 2007 to provide students with guidance and support for future success as faculty and to increase the number of faculty the Clark School produces. Students attend seminars and gain hands-on experience that enhances the skills necessary to become successful faculty members in both teaching and research.

All Future Faculty Fellows receive funding for travel expenses to professional conferences, where they can network with participants and become more confident in presenting research at a high level.

Travis given award for atomic layer deposition

Chemical and Biomolecular Engineering graduate student **Curtisha Travis** has won the American Institute of Chemical Engineers' Computing and Systems Technology Directors' Award. Travis is advised by Professor **Ray Adomaitis** (ChBE/ISR).

The award recognizes the division's best poster; Travis was recognized for "The Computational Challenges of Simulating Atomic Layer Deposition Process Dynamics." It described a model that predicts the optimal conditions for ALD of alumina when using water and trimethylaluminum as precursors.

Find ISR videos online!

ISR has hundreds of engaging videos available for you to view online.

Our faculty web pages include short interview videos describing research interests. We have available more than 200 lectures given by ISR faculty and guest speakers in the last five years, and more than 100 video demonstrations of our research in robotics and other areas.

In addition, ISR's M.S. in Systems Engineering degree website features a number of videos that explain the program, the model-based systems engineering approach and careers for graduates. It also includes a helpful video for new graduate students on choosing a faculty advisor and making the most of graduate school.

WATCH THIS VIDEO OF A STUDENT-BUILT "KOMODO DRAGON" ROBOT ON OUR YOUTUBE CHANNEL: *WWW.YOUTUBE.COM/UMDROBOTICS.*

See them for yourself!

ISR YouTube channel. More than 100 videos are available. Learn about ISR faculty research interests and hear faculty and students talking about ISR's educational opportunities and career opportunities in systems engineering. *ter.ps/2vr*

ISR lectures Vimeo channel. Choose from more than 200 full-length lectures presented at ISR on a variety of topics from systems engineering to robotics to communications networks to cybersecurity to information theory to MEMS and nanoscience, neuroscience and much more. Presenters include ISR faculty and noted guest speakers from around the world. *ter.ps/2vs*

Maryland Robotics Center YouTube channel. More than 100 videos of robotics research. Watch microrobots, unmanned underwater robotic fleets, micro air vehicles, stair-climbing robots, robots used in manufacturing, medical robots, robots inspired by animals, birds and insects, robots that can be teleoperated and much more. *ter.ps/2vt*

A. JAMES CLARK
SCHOOL OF ENGINEERING

The Institute for Systems Research
2167 A.V. Williams Building
University of Maryland
College Park, MD 20742

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SYSTEMS SOLUTIONS is a newsletter for colleagues, research partners, alumni and friends of the Institute for Systems Research, A. James Clark School of Engineering, University of Maryland.

ISR is a permanent state-supported institute of the University of Maryland within the A. James Clark School of Engineering, and one of the original National Science Foundation Engineering Research Centers.

CONTACT
2167 A.V. Williams Building, University of Maryland, College Park, MD 20742
Phone: (301) 405-6615

ISR ONLINE
Web: isr.umd.edu Facebook: ISRUMD
Twitter: ISR_UMD YouTube: ISRUMD *and* UMDRobotics Vimeo: isr

Editor: Rebecca Copeland
rebeccac@umd.edu

ISR research featured in national, international news

The Baltimore Sun recently wrote about the robotic fish research of Associate Professor **Derek Paley** (AE/ISR); Associate Professor **Sean Humbert** (AE); ISR alumnus and Michigan State University Associate Professor **Xiaobo Tan** (EE Ph.D. 2002), and Professor **Sheryl Coombs** of Bowling Green State University. The team has been working on bio-inspired flow sensing and control for autonomous underwater vehicles that mimic fish. The researchers are creating an autonomous underwater vehicle that can work in groups to find stationary objects by sensing changes in water flow.

Professor **S.K. Gupta** (ME/ISR) is often interviewed by the international media about trends in robotics. He recently was quoted in *The Economist* about current breakthroughs and the coming ubiquity of robotics. His Robo Raven project was the star of a *USA Today* video during National Robotics Week at the Smithsonian Air and Space Museum. Robo Raven also appeared on a *60 Minutes* segment about micro air vehicles, and was depicted in cartoon form in the Quebec children's science magazine, *Les Explorateurs*.

ISR-affiliated Professor **Jaydev Desai's** (ME) Minimally Invasive Neurosurgical Intracranial Robot was featured in a National Public Radio story about advances in brain surgery. The robot can be used while a patient is inside an MRI scanner.

ISR-affiliated Professor **Ben Shneiderman** (CS/UMIACS) was a guest on the *Kojo Nnamdi Show* on NPR station WAMU (Washington, D.C.), discussing electronic health records. The Human-Computer Interaction Laboratory's video of its Twinlist research was featured on the program's web page.

Professor **Michael Ball** (BMGT/ISR) is often a guest on shows highlighting the airline industry. Most recently he spoke about the opposition to the American Airlines-US Airways merger on "NewsTalk with Bruce DePuyt," live on Washington D.C.'s News Channel 8.