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SYSTEM SOLUTIONS
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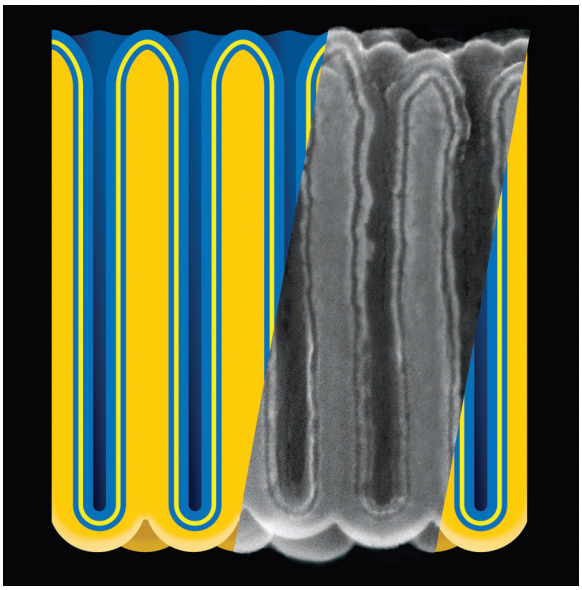
INSIDE

Rubloff to head new DOE Energy Frontier Research Center



Electrostatic nanocapacitors formed in nanoporous anodic aluminum oxide (darker yellow) film by sequential atomic layer deposition of metal (blue), insulator (yellow), and metal. Insert: cross-section of actual structure, represented as rescaled scanning electron micrograph. (Nature Nanotechnology/A. James Clark School of Engineering) ***See story on page 4.***

Professor **Gary Rubloff** (MSE/ISR) will lead a new Energy Frontier Research Center (EFRC) at the University of Maryland as part of a major new initiative by the U.S. Department of Energy (DOE).

EFRCs enlist the skills of the very best American scientists and engineers to address current fundamental scientific roadblocks to U.S. energy security—"grand challenges" in a broad range of research areas.

This EFRC addresses the "Science of Precision Multifunctional Nanostructures for Electrical Energy Storage." Its objective is to understand how nanostructures formed from multiple materials behave and to assess their potential for a new generation of electrical energy storage technology.

Nano-structured electrodes offer vastly greater surface area and smaller path lengths for motion of electrons and ions, increasing the rate at which charges can be moved and stored. This will lead to increased power and energy density and faster charging. By using materials in precisely built nanostructures, energy storage devices will hold more energy, charge or deliver electricity faster, and remain stable for longer lifetimes, while reducing space and weight.

Rubloff is a former director of ISR and current director of the Maryland NanoCenter. The research team includes faculty from three colleges—the A. James Clark School of Engineering, Chemical and Life Sciences, and Computer, Math and Physical Sciences. These faculty are also part of the University of Maryland Energy Research Center (UMERC) and the Maryland NanoCenter.

Collaborations are planned with scientists from the University of Florida, Yale University, the University of California, Irvine, Sandia National Laboratories, and Los Alamos National Laboratory, including the Center for Integrated Nanotechnologies at Los Alamos and Sandia.

Learn more about EFRCs at *www.sc.doe.gov/bes/EFRC.html*. ES

See related energy storage story on page 4.

Baras, Goldsman win Invention of the Year awards

Professor **John Baras** (ECE/ISR) and ISR-affiliated Professor **Neil Goldsman** (ECE) have each won a University of Maryland "Invention of the Year" award.

Information Science category

Baras was recognized for his work with the Army Research Laboratory on a key exchange system to secure Internet transactions. His invention is of interest to national defense systems, major banking companies, and other industries where secrecy is of great importance.

The efficient replacement of secret keys is a problem, since generating new keys can use a significant amount of computing resources. Baras and his fellow researchers discovered a method of efficiently updating and exchanging secret keys that exploits the randomness of Markov models in selecting a new key. This new method eliminates the need for third-party key management, public key infrastructure, and large amounts of storage space. Paul Yu and Brian Sadler also worked on this project.

Physical Science category

In the Physical Science category, Goldsman and Professor Martin Peckerar (ECE) won for their "World's Highest Energy Density Thin-Film Battery." The researchers developed an improved, thin-film battery prototype to respond to the need for more power-efficient electronic devices in a variety of applications. The millimeter-thick, high-density, rechargeable batteries offer the world's highest energy storage density among thin-film batteries. Remotely rechargeable, the batteries gather energy from environmental sources, such as solar energy, vibrations and radio waves. They can even recharge when a cell phone is pointed at them.

The batteries are flexible; they can conform to nearly any shape and be part of an electronic device's packaging. They can attach to microchips, sensors, RFID chips, and small electronic components.

The batteries are comprised entirely of environmentally friendly materials and will make possible a number of stronger, smaller products, including wireless sensor networks, active RFID, wearable electronics and medical devices. Yves Ngu, Zeynep Dilli and George Metze from the National Security Agency also worked on this project.

The start-up company based on the thin-film battery research, FlexEl LLC, also was the first-place winner in the information technology division of the University of Maryland's $75K Business Plan Competition in May. Team members in the competition included Goldsman, Peckerar, Dilli, and Josekuttan Manikathuparambil, a graduate student in the Master's Program in Telecommunications.

The Invention of the Year awards are presented annually by the University of Maryland Office of Technology Commercialization to honor outstanding inventions and inventors. Each year a panel of judges made up of both University of Maryland personnel and industry experts selects one winner from groups of finalists in each of three categories: life science, information science, and physical science. The winners are chosen based on the creativity, novelty, and potential benefit to society of each of the inventions.

Abed to become dean at United Arab Emirates University

ISR Director **Eyad Abed** (ECE/ISR) will become dean of the College of Information Technology (CIT) at United Arab Emirates University (UAEU) this fall.

A faculty member since 1983 and ISR director for the past seven years, Abed will take extended leave and maintain formal ties to the University of Maryland. He plans to establish a research partnership between the two universities in information technology and related areas.

UAEU officials said Abed will help establish "an institute of cross-disciplinary research across the university and industry, the Ph.D. program, a new post-doctoral fellowship program and strong linkages with leading researchers worldwide."

Abed said, "I will benefit greatly from my experience at Maryland, which is second to none in cross-disciplinary research and innovative approaches to education and outreach."

Clark School Dean **Darryll Pines** said, "Dr. Abed has been a valuable faculty member and ISR director in the Clark School, and we hope to continue collaborating with him in research and through partnerships with him in his new position at UAEU. We will miss him during this extended leave of absence and wish him the best in this exciting new venture."

Abed will continue to direct ISR through the summer. The Clark School of Engineering is currently conducting a search for the next ISR director.

ISR faculty participating in two DoD MURIs

ISR faculty members will be conducting research in two new Multi-University Research Initiatives (MURIs) recently announced by the Department of Defense (DoD). The DoD created a total of 41 MURI projects worth some $260 million in research funding.

Distributed Learning and Information Dynamics in Networked Autonomous Systems

Professor **John Baras** (ECE/ISR), ISR Director **Eyad Abed** (ECE/ISR) and Assistant Professor **Nuno Martins** (ECE/ISR) will be participating in an Air Force Office of Scientific Research (AFOSR) MURI, "Distributed Learning and Information Dynamics in Networked Autonomous Systems." Georgia Tech is the lead institution, and Jeff Shamma, who was an ISR Distinguished Lecturer in February, is the principal investigator. Besides Maryland, other participating institutions are the Massachusetts Institute of Technology and Johns Hopkins University. This award was made in the MURI category, "Learning Decision Architectures for Intelligent Cooperative Control of Autonomous Systems."

This research will build a foundation for advanced operations of autonomous vehicle teams to learn and adapt in uncertain and hostile environments while effectively using communications resources. The research will include studies of learning under sparse communications, game theoretic learning, and on-line formation of desirable network architectures. The methodological advances and principles obtained in the project also are expected to have implications for key problems in social, economic and biological networks.

Figure-Ground Processing, Saliency and Guided Attention for Analysis of Large Natural Scenes

Professor **Shihab Shamma** (ECE/ISR) will contribute to an Office of Naval Research (ONR) MURI, "Figure-Ground Processing, Saliency and Guided Attention for Analysis of Large Natural Scenes." Johns Hopkins University is the lead institution; besides Maryland, the other participants are Harvard University, Yale University and the California Institute of Technology. This award was made in the MURI category, "Bio-inspired Autonomous Agile Sensing and Exploitation of Regions of Interest within Wide Complex Scenes."

This MURI will advance the computational architecture of sensors in large acquisition systems so that surveillance tasks in large natural scenes with complex imagery can be better accomplished.

Shamma's contribution will be to define regions of interest both spatially and perceptually; to describe how visual and auditory search on perceptual objects is guided by bottom-up saliency and by top-down knowledge of target features; to search among these potential targets with a specific goal in mind; and to transfer the knowledge obtained from the neurophysiology, perceptual psychophysics and neural modeling into algorithms and architectures for solving problems of relevance. ≡S

NSA designates University of Maryland 'Center of Excellence'

The National Security Agency (NSA) has designated the University of Maryland as a National Center of Academic Excellence in Information Assurance Research.

The bid was coordinated by **Gerry Sneeringer**, Director of Information Technology Security in the University of Maryland Office of Information Technology. Four ISR faculty members provided ideas and material for the proposal: Professor **John Baras** (ECE/ISR), Associate Professor **Sennur Ulukus** (ECE/ISR), ISR-affiliated Associate Professor **Michel Cukier** (ME), and ISR-affiliated Associate Professor **Min Wu** (ECE).

NSA and the Department of Homeland Security (DHS) jointly sponsor the National Centers of Academic Excellence programs and began the Information Assurance Research program in 2007 to promote robust IA technology, policy, and practices that will enable the United States to effectively prevent and respond to catastrophic events. The program recognizes schools that foster an information assurance research focus in curriculum as well as labs. The program is establishing opportunities for IA research centers to drill deeper into solutions to securing the global information grid. It also provides NSA, DHS, and other federal agencies with insight into academic IA programs that can support advanced R&D capabilities.

Designated universities are eligible to apply for scholarships and grants through both the federal and Department of Defense information assurance scholarship programs. ≡S

major AWARDS

AFOSR: Non-Intrusive Forensic Analysis

ISR-affiliated Associate Professor **Min Wu** (ECE/UMIACS) is the co-PI for a three-year grant from the Air Force Office of Scientific Research (AFOSR) for theories and algorithms to perform non-intrusive forensic analysis on multimedia devices and digital content. Former ISR faculty member K.J. Ray Liu is the principal investigator (PI).

As multimedia devices and digital content have become ubiquitous, it has become critical to ensure that content, devices, and intellectual property are being used by authorized users for legitimate purposes, and to be able to forensically prove with high confidence when the case is otherwise. The research will exploit intrinsic fingerprints, inherent traces left by various processing steps when media data goes through acquisition devices and processing systems. This research will develop a holistic forensic framework to gather traces of evidence and answer who has done what, when, where, and how.

MIPS: hand-held diagnostic instrument; advanced speech enhancement software

Associate Professor **Pamela Abshire** (ECE/ISR) and Professor **Carol Espy-Wilson** (ECE/ISR) have received grants from the Maryland Industrial Partnerships Program (MIPS).

Abshire is partnering with the Rockville-based company Innovative Biosensors Inc. on a grant to develop a hand-held diagnostic instrument for Group B Streptococcus, a type of bacteria that causes illness in newborn babies, pregnant women and the elderly. The device will enable rapid, automated detection for clinicians at the point of care.

Espy-Wilson is working with Baltimore-based Juxtopia LLC on a grant to develop advanced speech enhancement software for Juxtopia's augmented reality products that need speech recognition to work in noisy environments.

The two projects are among 17 research collaborations in the 43rd round of MIPS awards. MIPS awards enable Maryland companies and university faculty to develop technology-based commercial products.

Fulbright Scholar grant: magnetic drug delivery

Associate Professor **Benjamin Shapiro** (AE/ISR) has obtained a Fulbright Scholar grant for "Optimization and control of magnetic drug delivery to better target chemotherapy to deep tumors."

The Fulbright Program, sponsored by the U.S. Department of State's Bureau of Educational and Cultural Affairs, is the U.S. government's flagship international exchange program and is supported by the people of the United States and partner countries around the world.

AFOSR: dynamic heterogeneous wireless networks

ISR-affiliated Professor **Christopher Davis** (ECE) and Civil Engineering Research Professor **Stuart Milner** have been awarded a three-year, $1 million AFOSR grant for "Quantifying and Assuring Information Transfer in Dynamic Heterogeneous Wireless Networks."

Researchers at the University of Maryland, Cornell University and the University of Illinois will conduct a theoretical investigation of next generation, complex, heterogeneous, wireless networks aimed at quantifying, controlling and managing information transfer for theater, tactical and strategic support.

In their previous AFOSR-sponsored research, Davis and Milner focused on scalability, control, and capacity limits of heterogeneous, wireless networks that involve mobile ad hoc networks (MANETs), links with disparate data rates from bits-per-second to above Gb/s, and directional wireless (free-space optical and RF) backbones, with an emphasis on the transfer of packets.

Davis and Milner will focus on network architectures and protocols that support information transfer. The researchers will address information-centric topology management and control vis-à-vis network topology management and control. The research will provide new analytical and mathematical tools to understand the factors affecting communication in complex wireless networks and their effect on network performance. ES

Electrical energy storage breakthrough

To save money and energy, many people are purchasing hybrid electric cars or installing solar panels on the roofs of their homes. But both have a problem—the technology to store the electrical power and energy is inadequate.

Battery systems that fit in cars don't hold enough energy for long driving distances, take hours to recharge and don't provide much power for acceleration. Renewable sources like solar and wind deliver significant power only part time, but devices to store their energy are expensive and too inefficient to deliver enough power for surge demand.

Researchers at the Maryland NanoCenter have developed new systems for storing electrical energy derived from alternative sources that are, in some cases, 10 times more efficient than what is commercially available. The results of their research were recently profiled in *Nature Nanotechnology.*

"Renewable energy sources like solar and wind provide a time-varying, somewhat unpredictable energy supply, which must be captured and stored as electrical energy until demanded," said NanoCenter Director **Gary Rubloff** (MSE/ISR). "Conventional devices to store and deliver electrical energy—batteries and capacitors—cannot achieve the needed combination of high energy density, high power, and fast recharge that are essential for our energy future."

Researchers working with Rubloff and his collaborator, Professor **Sang Bok Lee** (Chem), have developed a way to significantly enhance the performance of electrical energy storage devices.

Using new processes central to nanotechnology, they create millions of identical nanostructures with shapes tailored to transport energy as electrons rapidly to and from very large surface areas where they are stored.

Materials behave according to physical laws of nature. The researchers exploit unusual combinations of these behaviors (called self-assembly, self-limiting reaction, and self-alignment) to construct millions—and ultimately billions—of tiny, virtually identical nanostructures that can receive, store, and deliver electrical energy.

"These devices exploit unique combinations of materials, processes and structures to optimize both energy and power density—combinations that, taken together, have real promise for building a viable next-generation technology, and around it, a vital new sector of the tech economy," Rubloff said.

"The goal for electrical energy storage systems is to simultaneously achieve high power and high energy density so devices can hold large amounts of energy, to deliver that energy at high power, and to recharge rapidly, which is the complement to high power."

Electrical energy storage devices fall into three categories. Batteries, particularly lithium ion, store large amounts of energy but cannot provide high power or fast recharge. Electrochemical capacitors (ECCs), relying on electrochemical phenomena, offer higher power at the price of relatively lower energy density. In contrast, electrostatic capacitors (ESCs) operate by purely physical means, storing charge on the surfaces of two conductors. This makes them capable of high power and fast recharge, but at the price of lower energy density.

The Maryland research team's new devices are electrostatic nanocapacitors which dramatically increase energy storage density of such devices—by a factor of 10 over that of commercially available devices—without sacrificing the high power they traditionally characteristically offer. This advance brings electrostatic devices to a performance level competitive with electrochemical capacitors and introduces a new player into the field of candidates for next-generation electrical energy storage.

Where will these new nanodevices appear? The technology is being developed for mass production as layers of devices that could look like thin panels, similar to solar panels or the flat panel displays we see everywhere, manufactured at low cost. Multiple energy storage panels would be stacked together inside a car battery system or solar panel. In the longer run, they foresee the same nanotechnologies providing new energy capture technology (solar, thermoelectric) that could be fully integrated with storage devices in manufacturing.

"Our successes are built upon the convergence and collaboration of experts from a wide range of nanoscale science and technology areas with researchers already in the center of energy research," Rubloff said. ES

Student research spotlight: Israel Perez

Israel Perez, a Ph.D. student in Materials Science and Engineering advised by Professor **Gary Rubloff** (MSE/ISR), conducts research into how nanoporous anodic aluminum oxide can be used as a platform for energy storage.

He has created tiny energy-storing devices called Metal-Insulator-Metal (MIM) nanocapacitors. The innovation involves the use of a material called nanoporous anodic aluminum oxide (AAO) to boost energy density. This has resulted in a tenfold gain in the amount of energy that can be stored, which allows these nanocapacitors to compete with electrochemical supercapacitors as viable energy storage devices. Near-term applications include working in parallel with conventional energy storage devices in cell phones and laptops and eventually even becoming the sole energy source in such devices.

Perez's research involves synthesizing nanoporous AAO templates and studying the characteristic shapes and materials composition of the structures to better

understand the implications for energy devices built on their surfaces.

The Metal-Insulator-Metal (MIM) nanocapacitors are an example of an energy device created using these templates. Using atomic layer deposition (ALD), a thin-film deposition method able to deposit conformal films in high aspect ratio nanostructures, a three-layer MIM structure (TiN-Al_2O_3-TiN) was deposited into the nanopores of AAO templates. When he tested this structure, Perez found that using nanoporous AAO boosted the energy density of this simple MIM structure. It surpassed the capacitance density values reported for similar devices in the literature tenfold. The high power density characteristic of MIM electrostatic capacitors, coupled with this large improvement in energy density, makes the MIM nanocapacitors capable of competing with electrochemical supercapacitors as a viable energy storage device.

Zhou to join Univ. of Illinois U-C faculty

Enlu Zhou will join the Department of Industrial & Enterprise Systems Engineering (IESE) at the University of Illinois at Urbana-Champaign, as an assistant professor this fall.

Zhou received a Ph.D. degree in electrical engineering in May. She was advised by Professor **Steve Marcus** (ECE/ISR) and Professor **Michael Fu** (BMGT/ISR). She is a recipient of the NSF award for Cyberinfrastructure Experiences for Graduate Students in 2007, the Future Faculty Fellowship from A. James Clark School of Engineering in 2007-2009, and the ECE Distinguished Dissertation Fellowship in 2009.

Her research interests include decision making under uncertainty and/or partial observation; optimization; simulation; and control theory applications in supply chain management and financial engineering.

Siwak wins ARCS Fellowship

Nathan Siwak, a graduate student advised by Professor **Reza Ghodssi** (ECE/ISR), has won a 2009 Achievement Rewards for College Scientists (ARCS) Fellowship.

Siwak conducts research in the MEMS Sensors and Actuators Laboratory. His research activities are currently focused on creating cantilever microsystems that can detect various gases, vapors, aerosols, or other analytes of interest.

The ARCS fellowship offers student recipients a renewable award of $15,000 per year. The award is sponsored by the Metropolitan Washington Chapter of the ARCS Foundation, Inc.

Parag Banerjee wins MSA award

MSE graduate student **Parag Banerjee** has won the 2009 Presidential Student Award from Microscopy Society of America. He will receive the award at the MSA's Microscopy & Microanalysis 2009 Meeting this July in Richmond.

Banerjee received the award for his paper, "Crystallization Behavior of HfO_2 Nanotubes in Different Environments." The paper describes how nanotubes of amorphous hafnium oxide crystallize when heated under various conditions of mechanical stress and temperature. By studying the formation of tiny crystals in these nanotubes, Banerjee hopes to shed light on fundamental atomic rearrangements that occur in nanostructures during crystallization.

The award is based on the quality of the paper, and the student must be the first author. Banerjee will present his paper at the meeting.

Banerjee is advised by **Gary Rubloff** (MSE/ISR), director of the Maryland NanoCenter and former director of ISR.

Koev wins best poster award; university-wide student research contest

Stephan Koev, a spring 2009 Ph.D. graduate advised by Professor **Reza Ghodssi** (ECE/ISR), won the Best Student Poster Award at the 2008 MEMS Alliance Symposium. Koev's poster explained research on optical microcantilever sensors for liquid samples being conducted in the MEMS Sensors and Actuators Laboratory and the Center for Biosystems Research at the University of Maryland Biotechnology Institute.

The microcantilever device contains a tiny beam with a length close to the thickness of a human hair. When target analyte molecules such as DNA bind to the selective surface coating of the beam, it is slightly deflected. Koev has developed a method for measuring the beam deflection that eliminates the external setup. The method makes use of integrated optical waveguides placed in line with the microcantilever. The beam deflection modulates the power of transmitted light, which is measured with a compact photodetector.

In the spring, Koev won a university-wide graduate student research contest for this work and was featured in the February 2009 issue of *Research@Maryland*.

Ashis Banerjee wins grad student research prize

Congratulations to **Ashis Banerjee**, a graduate student of Professor **S.K. Gupta** (ME/ISR). Banerjee won first prize for his research poster, "Real-Time Path Planning for Automating Optical Tweezers based Particle Transport Operations" at the University of Maryland's Graduate Research Interaction Day.

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Fellows

Professor **Steven I. Marcus** (ECE/ISR) and ISR-affiliated Professor **Stuart Antman** (Math/IPST) have been elected Fellows of the Society for Industrial and Applied Mathematics (SIAM).

Fellowship honors SIAM members who have made outstanding contributions to the fields SIAM serves. The two professors are in the inaugural class of Fellows; the program was created in 2008. Marcus is a former ISR director and a former chair of the Department of Electrical and Computer Engineering.

Professor **Avis Cohen** (Biology/ISR) and ISR-affiliated Professor and Director of the University of Maryland Institute for Advanced Computer Studies **V.S. Subrahmanian** (CS/UMIACS) have been named Fellows of the American Association for the Advancement of Science (AAAS). Cohen is being recognized "for distinguished contributions in spinal regeneration and in the development of the fields of computational neuroscience and neuromorphic engineering, especially as applied to motor control." Subrahmanian is being recognized "for contributions in computer science and multidisciplinary computing, for techniques to implement multiple data sources, software programs, automatically build group behavioral models and forecast group behaviors."

Best paper awards

Associate Professor **S. Raghavan** (BGMT/ISR) and his former Ph.D. student **Robert Day** won the Institute for Operations Research and the Management Sciences (INFORMS) Computing Society Prize for best paper in the operations research/computer science interface. The prize was awarded for "Fair Payments for Efficient Allocations in Public Sector Combinatorial Auctions," published in *Management Science*.

The paper developed a methodology for determining the payments that winners in a combinatorial auction should make. It is likely to be used in U.S. government auctions for airport landing slots, as well as U.K. and Dutch government spectrum auctions.

Day is an assistant professor in Operations and Information Management at the University of Connecticut's School of Business. Raghavan has won the award twice; he is one of only two people to have done so.

Professor **John Baras** (ECE/ISR) and his co-authors, ISR Assistant Research Scientist **Vahid Tabatabaee**, ECE graduate student **George Papageorgiou**, and alumnus **Nicolas Rentz** (ECE M.S. 2007), received the Best Paper Award for Wireless Networks at the 2008 IEEE GLOBECOM Conference. All co-authors are former or current advisees of Baras.

"Performance Metric Sensitivity Computation for Optimization and Trade-off Analysis in Wireless Networks," introduces methods combining reduced loss network models for wireless MAC interference with automatic differentiation to design multi-hop wireless networks that meet performance specifications.

Professor **John Baras** (ECE/ISR) and two of his alumni, **Paul Yu** (ECE Ph.D. 2008) and **Brian Sadler** (ECE M.S. 1984) of the Army Research Laboratory, received the Best Paper Award for Information Technology/C4ISR at the 26th Army Science Conference (ASC 2008). "Power Allocation Tradeoffs in Multicarrier Authentication Systems" introduced pioneering methods for authentication techniques that exploit signal characteristics to uniquely identify radios. The paper described how multicarrier systems may use such techniques to stealthily authenticate while maintaining high levels of security and robustness. The three authors have jointly applied for two patents on this research. This is the second time Baras and his students have won this award. He and ISR alumnus Alvaro Cardenas won the same award in 2002.

Patent

Associate Professor **Benjamin Shapiro** (AE/ISR) and Associate Professor **Elisabeth Smela** (ME) have received U.S. Patent 7,523,608 for "Electrically Driven Microfluidic Pumping for Actuation." The actuation apparatus uses electrically driven fluidic pumping for generating large stresses and strains.

Major papers

"Pursuit and an Evolutionary Game," a paper by Professor **P.S. Krishnaprasad** (ECE/ISR); **Dr. Eric Justh**, and MIT Ph.D. student **Ermin Wei** has been published in The Royal Society's journal, *Proceedings of the Royal Society A*.

Neuroethologists who study flight behavior in insects and echolocating bats have known for some time that there are geometric regularities in the flight. The paper offers for the first time a possible evolutionary basis for the patterns.

Krishnaprasad writes, "It is observations of such pursuit behavior in nature that inspired our theoretical and computational work. Our work is a natural outgrowth of the experimental work in Professor **Cynthia Moss's** (Psychology/ISR) Auditory Neuroethology Laboratory and the papers that resulted from it."

A paper by **Konstantinos Gerasopoulos, Matthew McCarthy, Elizabeth Royston, James N. Culver** and Associate Professor **Reza Ghodssi** (ECE/ISR) has been selected to be part of "Highlights of 2008" by the *Journal of Micromechanics and Microengineering*.

Gerasopoulos is an MSE Ph.D. student and McCarthy, now a postdoctoral researcher at MIT, was a postdoc in the

MEMS Sensors and Actuators Lab. Culver is an associate professor and Royston, with the U.S. Patent and Trademark Office, was his Ph.D. advisee at the Center for Biosystems Research, University of Maryland Biotechnology Institute.

The paper, "Nanostructured nickel electrodes using the Tobacco mosaic virus for microbattery applications," explains how nanostructured nickel–zinc microbatteries can be developed using the Tobacco mosaic virus (TMV). TMV has been used to increase the active electrode area in MEMS-fabricated batteries. Genetically modifying the virus to display multiple metal binding sites allows for electroless nickel deposition and self-assembly of these nanostructures onto gold surfaces. TMV-modified devices exhibit a six-fold increase in battery capacities compared to devices with planar electrode geometries.

Promotions

Ray Adomaitis (ChBE/ISR), Reza Ghodssi (ECE/ISR) and ISR-affiliated Peter Sandborn (ME) have been promoted to full professor, and Ankur Srivastava (ECE/ISR) has been promoted to Associate Professor by University of Maryland President C.D. Mote. ISR's Jonathan Fritz has been promoted to Associate Research Scientist.

Awards and honors

Associate Professor Jeffrey Herrmann (ME/ISR) and his student Timothy W. Hoy have received the Institute of Environmental Sciences and Technology's (IEST) 2009 Maurice Simpson Technical Editors Award. It is presented to the authors of the best technical papers published by IEST during the preceding year. The pair were honored for their paper, "Optimal Utilization of Test Facilities to Replicate Operational Environments," published in the 2008 *Journal of the IEST*.

Professor Carol Espy-Wilson (ECE/ISR) has been included in the "Soul of Technology," exhibit in Palo Alto, Calif., which showcases the 50 most important African Americans in technology. Espy-Wilson is named among 16 "Educators" on the list, and was recognized for her research and scholarly work in speech recognition and speech science.

Keynote addresses

Professor John Baras (ECE/ISR) delivered the plenary keynote address, "Multi-hop Mobile Wireless Network Design: Implicit Cross-Layer Loss Models and Performance Sensitivities," at the 14th Annual International Conference on Mobile Computing and Networking (MobiCom 2008). Baras was honored for his research towards systematic, model-based design of mobile wireless networks.

ISR-affiliated Professor Christopher Davis (ECE) gave an invited keynote talk, "Emerging Technologies for Indoor Wireless Sensor Networks: the Last 100 Meters," at the Intelligent Sensors, Sensor Networks and Information Processing Conference (ISSNIP) in Sydney, Australia. ISSNIP is an annual international forum on recent advances in both theory and applications of intelligent sensors and smart systems in diverse areas ranging from manufacturing and defense to medical science and environmental monitoring.

Federal appointment

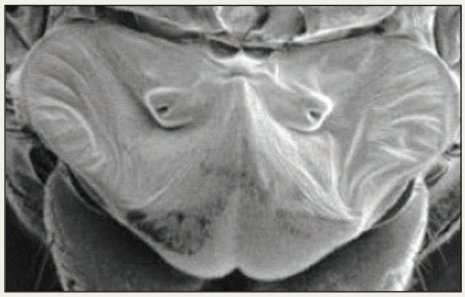
ISR systems engineering lecturer Nidak Sumrean has been appointed to the federal government's Senior Executive Service (SES). Sumrean teaches ENSE 626, "System Life Cycle Cost Analysis and Risk Management," in ISR's M.S. in Systems Engineering program. His position is the director of cost engineering and industrial analysis, NAVSEA 05C.

Editorships

Associate Professor Jeffrey Herrmann (ME/ISR) has been named to an editorial position for the Institute of Industrial Engineers' (IIE) *IIE Transactions*. He will be the departmental editor for homeland security for the journal's "Focused Issue on Operations Engineering and Analysis." This is a two-year term.

Associate Professor Ankur Srivastava (ECE/ISR) has been named associate editor for two publications: the Institute of Electrical and Electronics Engineers' *Transactions on Very-Large-Scale Integration (VLSI)*, the top journal in the VLSI field; and *Integration, the VLSI Journal*.

In the news



The type of fly ear used in Miao Yu's research. Photo courtesy of Miao Yu.

ISR-affiliated Assistant Professor Miao Yu's (ME) research into fly ear-inspired sensors was recently profiled by *Aerotech News and Review*, a journal of aerospace and defense industry news. The story details Yu's work in developing miniature acoustic sensors and sound localization techniques using the hearing mechanisms of flies as a model. The fly ear is a nature-designed optimal structure for obtaining the best acoustic directional cues at 5 kHz. Yu is replicating the fly ear's performance and design, and has developed an optical detection technique to make the system highly sensitive and able to filter out noise. ≡S

Struemper builds models to help speed new drug development

A career in the pharmaceutical industry might not be what you'd expect from someone whose dissertation involved theoretical work in motion control. But that's just what has happened with ISR alumnus **Herbert Struemper** (ECE Ph.D. 1997), who makes his living building models that help pharmaceutical companies address specific questions related to the development of new drugs.

Struemper works for the consulting firm Pharsight, modeling clinical data and developing simulations that support decision-making for drug manufacturers.

At ISR, Struemper worked with advisor Professor **P.S. Krishnaprasad** (ECE/ISR) in non-linear geometric control for unmanned aerial vehicles, satellites, and automobiles. After graduation, Struemper briefly was a lecturer in geometric control at the California Institute of Technology.

He developed an interest in systems technology and biology, building virtual models on drug interaction in the human body. In eight years at the consulting firm Entelos, Struemper built models of complex diseases and their underlying biology.

Struemper moved to Pharsight in 2007, building models to help shorten the length of time and reduce the expense involved in drug development.

A successful drug may cost some $800 million and take 14 years to come to market. This is because most pharmaceutical research and development is based on trial and error. Thousands of compounds are examined on the early end of drug discovery. The most promising are put into a pretrial phase, then tested on animals and finally on humans in clinical trials. Of the initial thousands, perhaps only 10 compounds make it as far as clinical trials.

Another difficulty is that sometimes drugs that work in animals do not work in humans, and vice versa. But drugs that don't work in animals may be dropped from consideration before they reach human clinical trials.

Mechanistic disease modeling (MDM) uses clinical data and an understanding of underlying biology to build models that mimic the progression of a disease. It could shorten time, reduce expense, and improve the efficiency of the discovery process by addressing questions that arise during the clinical phase, such as concerns the Food and Drug Administration might raise, or whether the company should continue with the research.

The core model is based on public, mostly preclinical in vitro/in vivo data. Struemper sifts through clinical data contained in medical studies and decides which are the most important. "This is a difficult part of the process," Struemper acknowledges. "The model's decisions should be mostly data driven, so choosing what to include is very important."

The biological markers are costly to build and maintain; Struemper took more than a year to build a model of a joint with rheumatoid arthritis. But once the model is created, the biological components can be used for models of other diseases.

"Right now it takes a lot of resources and time to start a new model," Struemper says. "So modeling is most useful for developing drugs for major diseases that many people suffer from, such as osteoporosis, rheumatoid arthritis, diabetes/obesity, asthma, and Alzheimer's Disease."

Struemper notes that drug company use of modeling is still in its infancy and needs to gain the trust of the industry as researchers become more experienced with its benefits. Long-term, Struemper expects modeling to play a significant role in drug discovery.

Struemper enjoys his applied engineering work because he has an impact not just on drug development but on people's lives. He envisions a time where, "if there are good, cost-efficient modeling methods, pharmaceutical companies will find it worthwhile to develop drugs for smaller-scale diseases as well as major diseases."

Considering the trajectory of his career, Struemper finds it interesting that he did not take biology courses in college, but got most of his education in this area post-graduation at the application level. He believes he succeeded in a new field because his degree was "not about the actual thesis, but the background of my education."

"Matrix algebra, statistics and estimation theory all continue to be important. I do a lot of things like model building, cellular assays, forming hypotheses about what is important in the disease and forming theories about what to do," he says.

"Because biology is so complex, I still consider the work I do to be a systems engineering problem." ≡S

Manikonda named IAI President

Vikram Manikonda (ECE Ph.D. 1997) is now the president of Intelligent Automation, Inc. (IAI), Rockville, Md. He is a former advisee of Professor P.S. Krishnaprasad (ECE/ISR).

Manikonda joined IAI in 1999 and was named director of IAI's Distributed Intelligent Systems Group in 2001 and its vice president in 2004. Manikonda's research has spanned nonlinear and geometric control, motion description languages, robotics, and the application of multi-agent systems agents to simulation, distributed control, and air traffic control and management.

At Maryland, Manikonda helped develop MDLe, a motion control language for robotics, and was manager of the Intelligent Servosystems Laboratory.

Alumni named Fellows

Nikos Sidiropoulos (ECE Ph.D. 1992) has been elected a Fellow of the Institute of Electrical and Electronics Engineers (IEEE) for "contributions to signal processing for communications." Sidiropoulos is a professor in the Telecommunications Division of the Technical University of Crete. He is a former student of Professor John Baras (ECE/ISR). After graduation, Sidiropolous was an ISR postdoctoral researcher and later an assistant research scientist at ISR and an adjunct professor for the Electrical and Computer Engineering Department. He was an assistant professor at the University of Virginia and an associate professor at the University of Minnesota before moving to the Technical University of Crete. He chaired its Electrical and Computer Engineering department from 2005-2007.

Qiang Yang (CS Ph.D. 1989) has been elected an IEEE Fellow for "contributions to understanding and application of intelligent planning, learning and data mining."

Yang is a professor in the Department of Computer Science at Hong Kong University of Science and Technology. He was a student of Professor Dana Nau (CS/ISR). After graduation, Yang was a visiting researcher at Microsoft Research China and the University of Washington. Prior to his work in Hong Kong, he was on the faculty of the University of Waterloo and Simon Fraser University, both in Canada.

Faculty appointment

Alkan Soysal (ECE Ph.D., 2008) has joined the faculty of Bahçeşehir University in Istanbul, Turkey as assistant professor in the Department of Electrical and Electronics Engineering. His research interests are in wireless communication theory, information theory and signal processing for wireless communications with particular focus on MIMO networks.

Soysal received his M.S. and Ph.D. degrees in electrical and computer engineering from the University of Maryland in 2006 and 2008, respectively. He was advised by Sennur Ulukus (ECE/ISR).

Academic promotion

Bill Byrne (ECE Ph.D. 1993) has recently been promoted to a Readership in Information Engineering in the Department of Engineering at the University of Cambridge in the United Kingdom. He was previously a Lecturer in Speech Processing. He also is a Fellow of Clare College, Cambridge. Byrne was advised by Professor Shihab Shamma (ECE/ISR). His current research interests are in speech recognition, speech synthesis, and statistical machine translation.

Heather (Haitao) Zheng (ECE Ph.D., 1999) has been promoted to associate professor with tenure in the Department of Computer Science at the University of California, Santa Barbara. She was advised by former ISR faculty member K. J. Ray Liu (ECE).

Zheng's research has focused on cognitive radio technology as a method for enabling wireless devices to more efficiently share available bandwidth. Zheng was featured in MIT *Technology Review's* short list of technological innovations "ready to have a big impact on business, medicine, [and] culture." She also was named to the magazine's "TR 35" list—those considered the top 35 technology innovators under age 35.

Best paper award

H. Vicky Zhao (ECE Ph.D., 2004) has received the IEEE Signal Processing Society's 2008 Young Author Best Paper Award for a paper she co-authored with her former advisor, K.J. Ray Liu (ECE). "Behavior Forensics for Scalable Multiuser Collusion: Fairness vs Effectiveness" appeared in the September 2006 issue of *IEEE Transactions on Information Forensics and Security*.

Zhao is an assistant professor of electrical and computer engineering at the University of Alberta. Her research interests include information security and forensics, multimedia, digital signal processing and communications. ES

Alumni: share your news with us!

We'd love to add ***your*** news to our roundup of alumni stories. Email us at rebeccac@umd.edu. And thanks!

TRX Systems, headed by ISR alumna, wins Global Security Challenge

TRX Systems, a company headed by **Carole Teolis** (ECE Ph.D. 1994), has won first place as "Most Promising Security Start-Up 2008" in the third annual Global Security Challenge (GSC) competition. Teolis was advised by Professor **John Baras** (ECE/ISR).

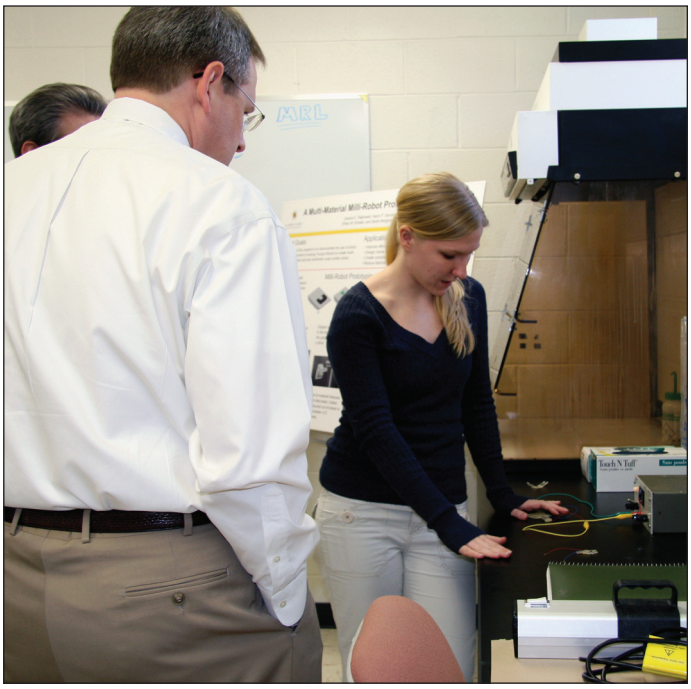
TRX's product, the Firefighter Sentinel System, can track individuals inside multi-story buildings with no special instrumentation or preparation. The product can provide accurate, reliable locations in three dimensions, indoors or outdoors, regardless of the local environment, weather conditions, or availability of a Global Positioning System (GPS).

TRX's map generation software is a key part of the company's intellectual property. The software enables first responders to generate a floor plan if one is not available when they arrive on scene. These floor plans can greatly improve situational awareness as well as improve tracking capability. The system's precision location and health information for deployed personnel also could lead to a dramatic decrease in rescue time for distressed or downed firefighters.

TRX was founded by Professor **Gil Blankenship** (ECE). The start-up company began in the Technology Advancement Program, part of the Maryland Technology Enterprise Institute, the University of Maryland's tech company incubator. It also received assistance from the Maryland Fire and Rescue Institute. In 2008, TRX was named the Maryland Incubator Company of the Year for Homeland Security. TRX employs 17 people; all but three are University of Maryland alumni. ES

Research Open House posters are online

More than 100 visitors attended ISR's Research Open House on Thursday, April 16. Guests from industry and government toured 18 laboratories and learned about the research of 30 faculty members and their students.



Research Open House guests learn about tiny autonomous mobile robots that move by jumping in Sarah Bergbreiter's Micro Robotics Laboratory.

Research areas represented included biology-inspired applications; communication; networks; security; control; robotics design; methdologies for multicore computing; energy; healthcare systems; logistics and operations; manufacturing; MEMS sensors, actuators and motors; model predictive control; semiconductor processing; and systems engineering.

Many of the research posters presented at the open house are available for you to view online at ISR's web site: *www.isr.umd.edu/research/posters.htm#2009.* ES

Sikorsky renews as ISR strategic partner

Sikorsky Aircraft Corp. has renewed its membership in ISR's Strategic Partners Program. Sikorsky is a world leader in designing, manufacturing and servicing military and commercial helicopters, fixed-wing aircraft; spare parts and maintenance, repair and overhaul services for helicopters and fixed-wing aircraft; and in civil helicopter operations. Sikorsky collaborates with Professor **André Tits** (ECE/ISR) to research advanced algorithms for rotorcraft control. Alumnus **Vineet Sahasrabudhe** (AE Ph.D. 1996), who was co-advised by Dr. Tits and Professor **Roberto Celi** (AE), is Sikorsky's technical lead. ES

Toshiba visitor conducts vibration reduction research

Mr. **Hiromasa Takahashi**, a researcher at Toshiba's Corporate Manufacturing Center in Yokohama, Japan, is an ISR Visiting Scholar continuing the research in vibration reductions begun by Toshiba's **Takeshi Yamanaka.** Takahashi is working with Professor **Balakumar Balachandran** (ME) in the Vibrations Laboratory. ES

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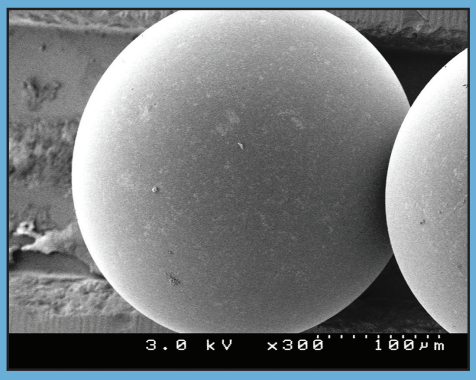
Ghodssi research featured on cover of *Mechanical Engineering*



Professor **Reza Ghodssi's** (ECE/ISR) research on microscale ball bearings was the cover story of the April 2009 issue of *Mechanical Engineering* magazine, the flagship publication of the American Society of Mechanical Engineers.

The article chronicles Ghodssi's research from his time as a postdoc and research scientist at Massachusetts Institute of Technology to his recent collaborations with the Army Research Laboratory and current research in his MEMS Sensors and Actuators Laboratory at the University of Maryland.

Ghodssi's microscale ball bearings are used in micromachines and Micro-Electro-Mechanical Systems (MEMS) devices to minimize friction and increase reliability.

Ghodssi currently is developing MEMS turbines that incorporate his microscale ball bearings technology, which can be used as the central components of miniature pumps, motors, and generators in a variety of applications. The microscale pumps could be used to feed liquid to miniaturized fuel cells, and Ghodssi's microscale turbines could power micro-generators.

For more information on Ghodssi's research, visit *www.isr.umd.edu/news/news_search_ghodssi.php.*

You also can visit the *Mechanical Engineering* magazine website at *memagazine.asme.org.* ES

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