SYSTEMSOLUTIONS

THE INSTITUTE FOR SYSTEMS RESEARCH

The Institute for Systems Research

Ghodssi, Rubloff part of $2 million NSF grant

Associate Professor **Reza Ghodssi** (ECE/ISR) and Maryland NanoCenter Director and Professor **Gary Rubloff** (MSE/ISR/ECE) are part of a new four-year, nearly $2 million National Science Foundation Emerging Frontiers in Research and Innovation-Cellular and Biomolecular Engineering (EFRI-CBE) grant. EFRI is NSF's newest and most competitive grant; only 12 were awarded in this cycle. "Biofunctionalized Devices—On Chip Signaling and 'Rewiring' Bacterial Cell-Cell Communication" will demonstrate signal translation by employing device-based electrical signals to guide the assembly of biosynthetic pathways, cell-based sensors, and cell-based actuators within a microelectromechanical system (MEMS); and will use on-board electrical, magnetic, mechanical, and optical systems to feedback and guide the cell-based system towards user-specified outcomes.

The principal investigator for the project is Professor **William Bentley**, chair of the University of Maryland's Fischell Department of Bioengineering. The investigative team also includes **Gregory Payne**, director of the Center for Biosystems Research at the University of Maryland Biotechnology Institute. Ghodssi is the principal investigator for the ECE/ISR portion of the grant.

The project targets the cell–cell communication system mediated by bacterial signaling

Gary Rubloff and Reza Ghodssi

autoinducers in a process known as quorum sensing. The PIs have created a computational model based on biochemical and biophysical processes that captures the dynamics of quorum signal generation, receptor driven recognition, and uptake. Cells will be signaled to initiate biofilm formation and maturation. The project includes an experimental MEMS platform for designing, constructing and testing this process. The environment will detect cell function and, by guiding signaling pathways, change cell phenotype in a controlled and directed manner.

The project may spawn new efforts in device fabrication, embedded sensor systems, bacterial pathogenicity, biofilm formation, genetic regulation and signal transduction. Developments could impact medicine (drug discovery, synthesis, and delivery), communications (biofunctionalized microfabricated devices), and security (smart sensors). ≡S

director's CORNER

Four new faculty members with exciting research interests are joining ISR this year.

I am pleased to announce that Professor **W. Rance Cleaveland** of the Computer Science Department is now an ISR jointly appointed faculty member. Rance is the executive and scientific director of the Fraunhofer USA Center for Experimental Software Engineering. He also cofounded Reactive Systems, Inc., which makes Reactis®, a model-based testing and validation tool for embedded software. His research interests are in formal methods for description and analysis of concurrent and distributed systems.

We also welcome **Nikhil Chopra**, a new assistant professor with a joint appointment in Mechanical Engineering and ISR. He earned his Ph.D. in Systems and Entrepreneurial Engineering at the University of Illinois Champaign-Urbana in 2006, and has been a postdoc there for the past year. His research interests are in control theory and applications, including in developing a fundamental understanding of synchronization and control of networked dynamical systems interacting over unreliable communication networks. This work is important in practical applications such as sensor networks, unmanned air vehicles, and robot networks.

In January 2008 we will be delighted to welcome **Sarah Bergbreiter** as an assistant professor with a joint appointment in Mechanical Engineering. Sarah earned a Ph.D. in Electrical Engineering and Computer Science at the University of California, Berkeley in May 2007. Her research interests are in mobile autonomous microrobots. She has done work in photo beacons for localization, jumping microrobots, and cooperation and distributed sensing in large robot networks.

We also are bringing **Patrick Kanold** to ISR as a new affiliate faculty member this fall. Patrick is an assistant professor in the Biology Department. He also is affiliated with the Program in Neuroscience and Cognitive Science (NACS) and the Center for Comparative and Evolutionary Biology of Hearing (C-CEBH). His current work focuses on early brain development, especially how transient and other early circuits shape the functional organization of the brain and how these circuits control the critical period. He earned his Ph.D. in Biomedical Engineering at the Johns Hopkins University in 2000 and won the Ralph E. Powe Junior Faculty Enhancement Award here at Maryland in 2007.

We're looking forward to many fruitful research collaborations with these faculty in the coming years.

ISR Director Eyad Abed

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Subrahmanian's models could help combat insurgencies

Computer models are still in their infancy and can provide only hints of possible outcomes during the often chaotic conditions in combat zones. Still, the U.S. military has considerable interest in integrating the cultural, behavioral, and economic aspects of its adversaries into combat.

ISR-affiliated Professor **V.S. Subrahmanian** (CS/UMIACS) and his colleagues at the Laboratory for Computational Cultural Dynamics have developed OASYS (Opinion Analysis System) software tools that automatically and quickly extract specific information about violent incidents from thousands of news reports. They use the information to tease out rules about the enemy's behavior and offer a probability estimate that a particular action might happen.

For example, Subrahmanian's team has looked at reports of suicide attacks by the Hezbollah group, based in Lebanon. Their preliminary results suggest that when the group is engaged in education and propaganda activities in a major way, there's a 46-47 percent probability it will carry out suicide attacks. When it is not engaged in such activities, the probability of an attack rises to about 80 percent.

"This is a very coarse finding, not the last word by any means," cautions Subrahmanian. Much more data and analysis would be needed to refine that rule as well as come up with other, increasingly useful ones.

Subrahmanian's team also did an automated analysis of 1,555 recent stories in the Afghan media to assess the perceived strength or weakness of Afghan President Hamid Karzai. The analysis searched for phrases containing both opinions and statements of fact that can influence opinions. It showed Karzai's overall rating was mildly positive for most sources.

The intensity of opinions can influence how a group might act during times of stress and conflict, Subrahmanian said. Behavioral scientists would like to find ways to accurately predict how a group might respond, and do so in a matter of hours or days rather than weeks or months.

Subrahmanian's software has been featured in the journal *Science* and at a recent seminar on Capitol Hill organized by the American Association for the Advancement of Science. He directs the University of Maryland's Institute for Advanced Computer Studies (UMIACS). Read the *Science* story at *www.sciencemag.org/cgi/content/full/316/5824/534* and the AAAS summary at *www.aaas.org/news/releases/2007/0625insurgents.shtml*. The OASYS website is at *oasys.umiacs.umd.edu/oasys/index.html.* ≡S

major**AWRDS**

Yu, Martins receive CAREER awards

Assistant Professor **Miao Yu** (ME/ISR), left, and Assistant Professor **Nuno Martins** (ECE/ISR), right, have received 2007 National Science Foundation Faculty Early Career Development (CAREER) Awards.

Martins' award is for "Distributed Control of Dynamic Systems Using a Wireless Communication Medium: Two New Paradigms."

Because most mobile wireless communication technologies feature interference, fading and power constraints, analyzing and designing these kinds of networked control systems are significantly more difficult than for wire-line systems. Martins' research will introduce two new paradigms to aid in such design.

Yu's award is for "Biology-Inspired Miniature Optical Directional Microphones: Bridging Biological Systems and Sensor Technology."

Yu's research will transfer biology-inspired ideas into smart, small-scale sensors. A new class of miniature directional microphones will be developed, inspired by the micro-scale ears of the Ormia fly. This sensing paradigm for sound localization is expected to have a significant impact in health care, safety, and defense.

The CAREER program fosters the career development of outstanding junior faculty, combining the support of research and education of the highest quality and in the broadest sense. ⌇S

Espy-Wilson part of $1.8 million grant for robust speech recognition

Professor **Carol Espy-Wilson** (ECE/ISR) is one of the principal investigators of a three-year, $1.8 million National Science Foundation (NSF) collaborative research grant for "Landmark-Based Robust Speech Recognition Using Prosody-Guided Models of Speech Variability."

The research will develop a system with performance comparable to humans in automatically transcribing unrestricted conversational speech, representing many speakers and dialects, and embedded in adverse acoustic environments.

Espy-Wilson's approach will apply new high-dimensional machine learning techniques, constrained by empirical and theoretical studies of speech production and perception, to learn the information structures that human listeners extract from speech. She will develop large-vocabulary, psychologically realistic models of speech acoustics, pronunciation variability, prosody, and syntax. She will derive knowledge representations that reflect those proposed for human speech production and speech perception, using machine learning techniques to adjust the parameters of all knowledge representations simultaneously in order to minimize the structural risk of the recognizer.

The work will improve communication and collaboration between people and machines and improve understanding of how humans produce and perceive speech.

Mary Harper, an affiliate research professor in the Computer Science Department and professor at Purdue University, is co-principal investigator of Maryland's portion of the grant. The project includes research at UCLA (Abeer Alwan, PI); University of Illinois Urbana-Champaign (Jennifer Cole, PI and Mark Hasegawa-Johnson, co-PI); Yale University (Louis Goldstein, PI) and Boston University (Elliot Saltzman, PI). ⌇S

Wu and Qu awarded AFOSR grant for high-performance trusted computing platforms

ISR affiliated Associate Professor **Min Wu** (ECE/UMIACS) and Associate Professor **Gang Qu** (ECE/UMIACS) have received a grant from the Air Force Office of Scientific Research (AFOSR) for research on novel applications of data hiding in computer programs. Wu is the principal investigator and Qu is co-PI for the three-year, $300,000 grant.

Performance and security are two of the most important design requirements for computing systems that carry out critical defense and commercial missions. This research effort will investigate building a high-performance trusted computing platform based on novel data hiding algorithms that embed information into compiled program binaries. The embedded data can be extracted during the program's execution to help the system enhance performance and provide trustworthy computing. ⌇S

Directional hybrid wireless networks grant for Davis, Milner

ISR-affiliated Professor **Christopher Davis** (ECE) and former ISR Research Scientist **Stuart Milner** (CEE) have been awarded a three-year, $270,000 NSF grant for "Transceiver and Network Technology Developments for Directional Hybrid Wireless Networks."

The research will create a communication tier using autonomously configuring directional links in a flexible backbone network that connects MANET-like small clusters. It will address important, unsolved research problems in stabilization, pointing, acquisition, tracking (SPAT), bootstrapping, and topology control algorithms needed to make "hybrid" directional free space optical (FSO) and radio frequency (RF) networks a reality. ⌇S

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Krishnaprasad, Baras, Moss part of new MURI awards

ISR faculty are on three research teams that have been awarded new Department of Defense Multi-Disciplinary University Research Initiative (MURI) grants.

Designing Reliable and Secure Tactical MANETs

This project, headed by Principal Investigator Virgil Gligor (ECE), includes ISR Founding Director and Professor John Baras (ECE/ISR) and his former student and ISR alum Radha Poovendran (EE Ph.D. '99), now an associate professor at the University of Washington. They are joined by teams from Carnegie Mellon and the University of Illinois Urbana-Champaign.

This research will develop and implement practical techniques to integrate mobile ad-hoc network (MANET) reliability and security for tactical operations, achieving superior performance characteristics in the face of both failures and deliberate adversary attacks.

Exploiting Nonlinear Dynamics for Novel Sensor Networks

Professor P.S. Krishnaprasad (ECE/ISR) is an investigator on this team led by former ISR Professor Edward Ott (ECE/PHY). The Maryland team is partnered with a team from Duke University.

This research will develop novel nonlinear dynamics-based concepts, devices and networks for military sensing applications. Experiment, theory and computational techniques will be used to develop radio-frequency, microwave, optical and acoustic sensors based on concepts from nonlinear dynamics.

Biologically-Inspired Flight for Micro Air Vehicles

Professor Cindy Moss (PSY/ISR) is on this team led by Principal Investigator Kenny Breuer at Brown University.

The program will study bat flight to understand and model the complex inter-related mechanisms bats use; and explore ways in which this can be translated to the design of engineered micro air vehicles. Researchers will focus on how bats' flexible skeletons, compliant wing membranes, highly articulated joints and distributed hair sensors function in the fundamental mechanics of unsteady flight and the neurophysiology of flight sensing and control. ≡S

MIPS grants: Baras, Liu, Davis

ISR faculty are associated with three new Maryland Industrial Partnerships (MIPS) contract awards. The MIPS program provides matching funding for university-based research projects that help companies develop new products.

Professor John Baras (ECE/ISR) is developing software that will enable first responders and emergency management organizations to seamlessly use wireless phones and devices during a catastrophic network outage, regardless of the phone services they are using. He is partnering with CI Technologies, LLC, Frederick, Md.

Professor K.J. Ray Liu (ECE/ISR) is partnering with Mobitrum Corp., Silver Spring, Md., to develop a software library for manufacturers of 802.11n wireless internet equipment to use in easily programming wireless routers, switches and PC cards.

ISR-affiliated Professor Chris Davis (ECE/ISR) is working with MFX Technologies, Inc., College Park, Md., to develop algorithms and a searchable database of signatures for explosive and non-explosive liquids and solid chemicals. These will be coupled with MXF's advanced X-ray technology to detect and identify explosives at checkpoints in bottles, containers and luggage. ≡S

Herrmann featured in Centers for Disease Control video

Associate Professor Jeffrey Herrmann (ME/ISR), along with Kay Aaby from the Montgomery County, Md., Advanced Practice Center for Public Health Emergency Preparedness and Response, spent a day in Atlanta this spring taping a television show for the federal government's Centers for Disease Control and Prevention (CDC). Herrmann and Aaby spoke about the partnership between the University of Maryland's research group and the Montgomery County government in making mass dispensing/vaccination clinics more effective and efficient. Herrmann also demonstrated his Clinic Planning Model Generator software, which the CDC requires agencies that receive federal funding to use in setting up clinics.

Mass Antibiotic Dispensing: Taking the Guesswork Out of Point of Dispensing Design is available to view online at the CDC's Public Health Training Network: *www2.cdc.gov/PHTN/webcast/poddesign/default.asp.* Dr. Herrmann appears at 31:50 into the program. ≡S

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industryNEWS

Toshiba renews strategic partners membership

ISR is pleased to announce that Toshiba CMC has renewed its long-standing membership in ISR's Strategic Partners Program and started two new joint research projects. Professor **S.K. Gupta** (ME/ISR) will work on design for manufacturing, while **Yiannis Aloimonos** (UMIACS) will research image processing. ISR Director **Eyad Abed** (ECE/ISR) said, "We are very pleased to have Toshiba renew its partnership with ISR in areas of shared strategic priorities, and look forward to these new collaborations."

Summer interns at IAI

ISR's Intelligent Servosystems Lab (ISL) placed two summer interns at Intelligent Automation Inc. (IAI), Rockville, Md., this year. **Matteo Mischiati,** a first-year ECE Ph.D. student and advisee of Professor **P.S. Krishnaprasad** (ECE/ISR), was a graduate intern working on path planning algorithms for mobile robot teams, which will be implemented on a collection of AmigoBot robots. Mischiati worked closely with IAI senior scientist **Babak Azimi-Sadjadi,** an alumnus of ISR and ECE (Ph.D. 2001, advisee of **P.S. Krishnaprasad**).

Philip Twu was an IAI undergraduate intern. He will be a senior this fall with a double major in electrical engineering and computer science. Twu worked closely with IAI engineer **Zachary Kulis,** an ISR and ECE alumnus (M.S. 2006, joint advisee of **P.S. Krishnaprasad** and **Eric Justh**). He completed a new agent-based implementation of MDLe for open sourcing. MDLe is a motion control language for robotics, initiated in 1994 in the ISL as a part of **Vikram Manikonda's** M.S. thesis. Manikonda received his Ph.D. in 1997, and is now vice president at IAI. MDLe has undergone further development and implementations at ISL. In its new implementation, MDLe will use Cybele, a distributed agent framework and IAI software product.

Mischiati and Twu are the first interns at IAI in a new collaborative program with ISL, initiated thanks to the efforts and support of Vikram Manikonda.

Honda engineer completes visit

In July ISR said farewell to Honda Visiting Scientist **Mr. Shigeru Narihiro**, who spent 14 months conducting control theory research with

Honda Visiting Scientist Mr. Shigeru Narihiro

Associate Professor **Robert Sanner** (AE) and ISR-affiliated Associate Professor **Dave Akin** (AE). His final presentation was titled, "Control Algorithms for Autonomous Rendezvous and Docking with SCAMP." Mr. Narihiro is an engineer working on automobile engines at the Tochigi, Japan Automobile R&D Center. ≡S

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Shneiderman associated with federal government web projects

ISR-affiliated Professor **Ben Shneiderman** (CS/UMIACS) has been in the news recently for his work with federal government-related web resources. This spring Shneiderman and Jennifer Preece, professor and dean of the university's College of Information Studies, received widespread media attention for their ideas about how to provide better networking at a time of disaster. The pair initially reported their research in *Science* magazine's "Policy Forum" feature.

Shneiderman and Preece's research suggests that registered community members could use Internet-based computers, mobile devices and cell phones to give and get text messages, photos or videos. Based on the concept of social networking used at MySpace, Facebook and YouTube,

"911.gov" would support coordination, and emerging software tools could enable agencies to integrate reports and promptly recognize patterns. Civic leaders could disseminate information on a street-by-street basis.

These "Community Response Grids" (CRGs) would be most useful in catastrophes that do not destroy infrastructure, such as avian flu, chemical and biological attacks, and temperature extremes.

Shneiderman said, "We know the large majority of first responders are citizens close by. We need to create a training program to make them responsible responders, and to engage them in a practical way." The University of Maryland may implement a prototype CRG system sometime in 2007.

Shneiderman was one of the experts guiding a new 267-page publication, *Research-Based Web Design and Usability Guidelines,* which helps federal agencies build better web sites. The publication can be downloaded at *www.usability.gov/pdfs/guidelines.html.* Shneiderman also wrote the book's forward and calls it the best of the guideline books for informational web site design. His suggestions for federal web managers: test your site with real users doing real tasks, build in a plan for regular feedback, and assess usage continuously.

Shneiderman's favorite federal web sites are the Library of Congress site, the Census Bureau site and the National Library of Medicine's *Medline Plus.* The sites provide "remarkable content and convenient access," he said. ≡S

faculty NEWS

Promotions

John Consoli

Carol Espy-Wilson (ECE/ISR) has been promoted to the rank of full professor and **Richard La** (ECE/ISR) has been promoted to associate professor with tenure. Both promotions became effective July 1, 2007.

University of Maryland awards

Professor **K. J. Ray Liu** (ECE/ISR) has been selected to become a Fellow of the Academy of Excellence in Teaching and Learning (AETL) at the university, beginning this fall. AETL is a community of scholars committed to fostering a culture of excellence in teaching and learning. The group serves as an advisory body to the provost and the campus leadership on a broad range of issues pertaining to teaching and learning, promoting scholarly dialogues, innovative projects, and educational excellence and scholarship. Liu joins a group of 33 AETL Fellows, including Professor **Tony Ephremides** (ECE/ISR).

Professor **Shihab Shamma** (ECE/ISR) is the recipient of the 2007 ISR Outstanding Faculty Award. He was nominated by Professor **P.S. Krishnaprasad** (ECE/ISR), who has collaborated with him on wavelet representations of signals, sound localization, and sound source separation.

Shamma's contributions to science are in hearing research. His primary focus has been to uncover the computational principles underlying the processing and recognition of complex sounds (speech and music) in the auditory system. The work of his group has led to signal processing algorithms for applications in a variety of contexts, including speech and speaker recognition, diagnostics in manufacturing processes, and battlefield acoustics. Additionally, he has guided the development of new cochlear processing chips and VLSI implementations of auditory processing algorithms for use in robotics.

Patents

University of Maryland Provost and former Clark School Dean **Nariman Farvardin** (ECE/ISR) received U.S. Patent No. 7,221,804 for research in collaboration with Mitsubishi Electric Corp. Farvardin and Eiji Atsumi of Kamakura, Japan, developed a method and apparatus for compressing and decompressing images. Specifically, the method allows for selecting a region of interest in an image, which is then given priority in the encoding process. This can result in increasing the speed and/or fidelity of the reconstructed region of interest. The system enables more effective reconstruction of digital images over communication lines and could be incorporated into a digital camera.

Assistant Professor **Miao Yu** (ME/ISR), Professor Balakumar Balachandran (ME), and Research Associate Moustafa Al-Bassyiouni (ME) were awarded U.S. Patent No. 7,224,465 for "Fiber Tip Based Sensor

System for Measurements of Pressure Gradient, Air Particle Velocity and Acoustic Intensity." The invention is a fiber optic sensor system for pressure measurements where the design permits multiplexity on the input and optical parts of the system. It has a sensor Fabry-Perot interferometer and a read-out interferometer, and is based on low-coherence fiber optic interferometry techniques.

Invited lectures

Professor **John S. Baras** (ECE/ISR) was an invited featured speaker at the MIT Enterprise Forum (MITEF)-hosted Tech Transfer Lab, which focused on mobile technologies. Baras presented his invention (joint with his former advisees and ISR alumni **Junfeng Gu** and **Yimin Jiang**) of a new method and apparatus for conditional access in broadcast/multicast systems. The invention is part of U.S. Patent 7,006,568, "3D Wavelet Based Video Codec with Human Perceptual Model," issued to Baras, Gu and Jiang in 2006. "This is really two patents issued as one," Baras said. The key invention uses an integrated approach of signal representation via three-dimensional wavelets, perceptual models of the human vision system, and advanced compression techniques to provide efficient and substantial compression of video streams.

In April, Baras delivered the invited keynote address at the Control over Communication Channels Workshop, part of the 5th International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks in Limassol, Cyprus. His title was "Robust Feedback Control vs. Uncertainty Model Complexity: From Information Theory to Networked Control."
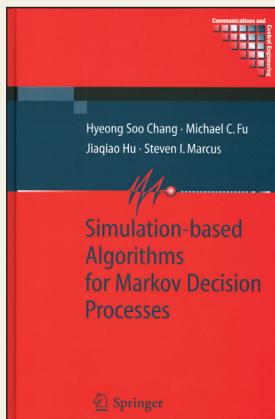
Professor **Tony Ephremides** (ECE/ISR) presented a plenary lecture, "At the Crossroads of Layer Crossing," at the 37th IEEE Communication Theory Workshop

in Sedona, Ariz. in May. The workshop attracts prominent researchers in information theory, communication theory and networking. Ephremides also delivered a plenary lecture at the same workshop last year in Puerto Rico, where he spoke about "What is in Sensor Networks for Communication Theorists." This was the first time someone had been selected as plenary speaker two years in a row at this workshop.

Associate Professor **Reza Ghodssi** (ECE/ISR) is among 83 young engineers invited to attend the National Academy of Engineering (NAE) 2007 U.S. Frontiers of Engineering Symposium in Redmond, Wash., this September. The symposium brings together a select group of the nation's outstanding young engineers (age 30-45) from industry, academia, and government to discuss pioneering technical and leading-edge research in fields other than their own, facilitating cross-disciplinary collaboration and the transfer of new approaches and techniques. Ghodssi was nominated by University of Maryland President C.D. (Dan) Mote.

Books

A new book, *Simulation-Based Algorithms for Markov Decision Processes,* has been co-written by four authors with ties to ISR. The new publication is in Springer's Communications and Control Engineering series. The authors are former ISR Director and Professor **Steve Marcus** (ECE/ISR); Professor **Michael Fu** (Robert H. Smith School of Business/ISR); former

ISR postdoctoral researcher **Hyeong Soo Chang,** now teaching at Sogang University in Seoul, Korea; and ISR alumnus **Jiaqiao Hu,** who was advised by Drs. Marcus and Fu and is now an assistant professor at SUNY Stonybrook. In addition to providing numerous specific algorithms, the exposition includes both illustrative numerical examples and rigorous theoretical convergence results. The book appeals not only to researchers in MDPs, simulation, and stochastic modeling and control, but also is a valuable source of instruction and reference for students of control and operations research.

Faculty in the news

The Discovery Science Channel recently featured ISR-affiliated Associate Professor **Dave Akin** and his Space Systems Laboratory on the show *Hubble and Beyond: Telescopes in Space.* The neutral buoyancy tank in Akin's lab is providing the environment to test robots for an upcoming NASA robotic mission to repair the Hubble Space Telescope.

The A. James Clark School of Engineering profiled five ISR professors and an additional ECE professor in its spring 2007 issue of *E@M* magazine. The story, titled "More Voices, More Choices," highlights research that is moving the wireless world forward in speed, access, connectivity, quality, security, and complexity. Featured are Professors **Tony Ephremides** (ECE/ISR), **K.J. Ray Liu** (ECE/ISR) and **Prakash Narayan** (ECE/ISR); and Associate Professors **Sennur Ulukus** (ECE/ISR) and **Richard La** (ECE/ISR). Also part of the group is ECE Associate Professor Gang Qu. Download the issue at *www.eng.umd. edu/media/e-at-m/07_e@m_spring.pdf.*

A research team led by ISR-affiliated Professor Christopher Davis (ECE) and ECE Research Scientist Igor Smolyaninov

has published "Magnifying Superlens in the Visible Frequency Range" in the journal *Science.*

The team has developed a powerful, nanoscale microscope using advanced applications of plasmon technology. Plasmons, electron waves generated when light strikes a metallic surface, are used in the microscope to help scientists see fine, nanoscale details that were previously undetectable. The *Science* article, written by Smolyaninov, Davis and Yu-Ju Hung, documents the team's pioneering efforts in developing a superlens and integrating it into a conventional optical microscope to image objects smaller than the limit determined by the diffraction of light waves.

Smolyaninov and Davis said that the two-dimensional plasmon microscope has the potential to image living cells, viruses, proteins, DNA molecules, and other samples, and could ultimately operate much like a point-and-shoot camera. The team believes they can improve the resolution of their microscope images to around 10 nanometers. By comparison, the width of a human hair is approximately 80,000 nanometers. This new technology could revolutionize the capability to view nanoscale objects at a crucial stage in the development of nanotechnology.

The innovation also was highlighted in an online news article on *Nature's* website. The team's technology was previously featured in an American Physical Society news article in October 2006, and was featured in its *Physics News in 2006* compilation of important developments during the year. ⌴S

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Ingar Grev applies systems concepts in business world

When ISR alumnus **Ingar Grev** (MSSE '98; MBA '05) decided to follow his entrepreneurial spirit, he brought his systems engineering education and training along, using his skills in highly effective and sometimes surprising new ways.

Grev earned a B.S. in Systems Engineering at the Naval Academy, and saw ISR's MSSE degree as a natural next step in an engineering career. His advisor was Professor **Michael Ball** (Robert H. Smith School of Business/ISR). It was as he was completing the core curriculum for the MSSE that Grev made acquaintances with business leaders and began to consider avenues for his skills in the business world.

At the same time, Grev was working for Bell Atlantic (now Verizon), in business process reengineering. "This got me thinking about how one could apply systems engineering principles to organization design methodology," he says.

Grev finished the MSSE as he was in a job transition from Verizon to Booz Allen Hamilton, but within three months he was recruited to help start the Ballistic Missile Defense Office's National Missile Defense (NMD) program for Photon Research Associates. Grev took respon-

sibility for developing the requirements for the interfaces between major system elements. After about six months, when people had been hired to manage each individual interface and things began to slow down, Grev felt his "business 'jones' begin to kick in," and he looked for opportunities to be an impact player in a technology-heavy business. In 2000 he moved to Covad Communications, a provider of T1 lines, DSL, broadband and VoIP services.

Grev also decided to pursue an MBA in Maryland's Smith School in addition to working full time.

Hooked on business

"I really had decided that I wanted to lead a business, either as an entrepreneur or as the CEO of an established company," Grev says, "so I pursued the MBA to get the tools that my career path wasn't really giving me." In his MBA program, Grev concentrated on corporate finance, organizational strategy, data analysis, and entrepreneurship classes.

At Covad, Grev built forecasting tools and implemented statistical process controls for staffing and capacity expenditures, and also modeled networks with discrete elements. He realized his systems engineering background and modeling experience were valuable assets and were highly beneficial to the organization. Grev's work is still in use at Covad; he estimates that his team saved the company about $20 million, or about 5 percent of revenues, out of its operating budget during his time there.

In May 2003 he returned to Photon Research Associates, now a wholly-owned subsidiary of Raytheon. Grev manages several programs in his current position as director, program operations. The largest of these is a research and development project for the Missile Defense Agency's Project Hercules that develops advanced software solutions for the Space Tracking and Surveillance System (STSS). Grev finds his systems perspective is valuable here too—he is able to see how one piece, such as a satellite, can help the system as a whole solve problems.

In his role evaluating research development, Grev uses his systems perspective to help determine whether principal investigators can develop technology as they promise, or whether the development is languishing. He also makes sure the research is relevant and meets the requirements of its customers.

Systems engineering advantages

Although Grev didn't end up pursuing engineering as a career, he credits his education at ISR with teaching him three critical things. First is the ability to do systems thinking. "I view everything as a system now," Grev says, "and the advantage is that I usually am one of the few people in the room who has the really big picture about how everything interacts."

"My hot button these days is understanding the human-in-the-loop and how he or she impacts system effectiveness in ways so profound, that you are foolish to design a system without getting users involved early on. I think we neglect optimizing the human in the loop at our peril. A lot of engineers and scientists don't spend a lot of time out in the field actually working with people. I have found that

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when you properly understand the human, you create a more robust system.

The second lesson Grev learned came from Associate Professor **Mark Austin's** (CEE/ISR) requirements engineering class. What Grev understands is that in requirements generation, just because a customer *thinks* they know what they want doesn't mean that they really do. "A competent manager needs to work with a client to really understand requirements," Grev says. "It is my job to help the customer determine this and then figure out how to get them there."

Grev developed tools and built a team that optimized capacity in more than 1,800 Covad central offices (COs) while also optimizing staffing needed to install or redeploy that capacity. Initially, several COs had critical shortages of capacity while most had significant excess capacity. Grev developed a model of the entire network of discrete elements (e.g. linecards, test equipment, etc.), which allowed his team to effectively manage capacity, mitigate forecast risks, and provide realistic material requirements to the supply-chain manager. By taking control of when capacity would be installed in the network, using just-in-time principles, Grev was able to build simulations of the network's growth based on the growth and shrinkage—or "churn" of the customer base.

Grev's team also created a virtual inventory of underutilized capacity, which allowed capacity from one CO to be harvested to satisfy requirements in another. The model also ensured that a technician wouldn't need to return to the CO where capacity was harvested to reinstall it for at least six months. This helped technicians buy into the harvesting plan, ensured that staffing was not used ineffectively, and eliminated the need to purchase—or even ship—new capacity.

Grev estimates that using this just-in-time approach, Covad had the capacity it needed to provision its customers 99.72 percent of the time and reduce the amount of excess capacity in the network.

An entrepreneur's heart

"Over the years I guess I hung out with too many entrepreneurs," Grev says. His passion is owning his own business, and recently he has found a way to do just that. In addition, he's making the most of his systems engineering and business skills, while adding to his contacts and strengthening his standing the business world. Grev bought a franchise in "The Growth Coach," a business coaching service, and now has his own independent office. So in addition to his day job, Grev now helps small business owners become strategic business owners. "The Growth Coach lets me see into a whole new world," Grev says. "I really want to help entrepreneurs become successful and do what they want to do. It's all about helping people see the bigger—systems—picture of what it is they really want." ≡S

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alumni**NE**WS

Naomi Leonard, a professor of Mechanical and Aerospace Engineering at Princeton University, has been named an IEEE Fellow for her contributions to control of underwater vehicles. Leonard is a 1994 Electrical Engineering Ph.D. and won the ISR Outstanding Graduate Student Award for 1992-1993. Her advisor was Professor **P.S. Krishnaprasad** (ECE/ISR). Previously she won a MacArthur Fellow "genius grant" in 2004.

IEEE has also named ISR alumnus and former faculty member **Leandros Tassiulas** a Fellow for his contributions to algorithms, protocols and architectures of wireless communication networks. Tassiulas is a professor in the Department of Computer and Communication Engineering at the University of Thessala in Volos, Greece.

He received his Ph.D. in Electrical Engineering in 1992 and was advised by Professor **Tony Ephremides** (ECE/ISR).

Victor De Oliveira has been elected as a member of the International Statistical Institute. He is an associate professor in the Department of Management Science and Statistics in the College of Business at the University of Texas at San Antonio. His research interests are in Bayesian methods, environmental statistics, geostatistics, Markov random fields, spatial prediction and space-time modeling. De Oliveira earned his Ph.D. in Mathematics in 1997 and was advised by ISR-affiliated Professor **Benjamin Kedem** (Math).

Steve Haga has been appointed as an assistant professor in the Department of Computer Science and Engineering at National Sun Yat-Sen University, Taiwan. Haga received a Ph.D. in computer engineering from the University of Maryland in December 2005 and was advised by Associate Professor **Rajeev Barua** (ECE/ISR). His research is in compiler techniques for embedded processors.

Wade Trappe has been promoted to associate professor with tenure in the Electrical and Computer Engineering Department at

alumniNEWS

Rutgers University. Trappe earned his M.S. in 1999 and 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/ISR). His research focuses primarily on wireless security, ad hoc and sensor network security, and multimedia security.

Andrew Newman has been appointed to the principal professional staff at the Johns Hopkins University Applied Physics Laboratory (JHU/APL). His work focuses on data fusion and sensor resource management for military intelligence, surveillance, and reconnaissance systems. Newman earned a Ph.D. in Electrical and Computer Engineering in 1999. His advisor was Professor **P.S. Krishnaprasad.**

Fumin Zhang

Fumin Zhang will join the School of Electrical and Computer Engineering at the Georgia Institute of Technology as an assistant professor in September 2007. Zhang earned his Ph.D. in Electrical Engineering from the University of Maryland in 2004. He was advised by **Professor P.S. Krishnaprasad** (ECE/ISR). Currently he is a lecturer and postdoctoral

research associate in the Department of Mechanical and Aerospace Engineering at Princeton University. He has been working with ISR alumnae Professor **Naomi Leonard** on control laws and sensing algorithms for underwater mobile sensor networks and adaptive sampling. His research interests are in long endurance robotic sensor platforms, mobile sensor networks, and nonlinear systems theory.

Ram Venkataraman Iyer has been promoted to associate professor with tenure in the Department of Mathematics and Statistics, Texas Tech University, Lubbock. Iyer earned his Electrical Engineering Ph.D in 1999, advised by Professor **P.S. Krishnaprasad** (ECE/ISR). He then worked as a postdoctoral researcher with Krishnaprasad until August 2000. From there Iyer worked at AFRL, Wright-Patterson AFB until August 2001. He joined Texas Tech in the fall of 2001 as an assistant professor. Iyer's research interests are in systems and control theory in the context of Aerospace and Smart Structures.

Ajay Gupta and his Greenbelt, Md.-based company, Gsecurity, Inc., recently chaired Maryland Governor O'Malley's cyber security and data privacy transition work group. Gsecurity is a cybersecurity and data privacy firm that offers consulting services, training programs and software products to the healthcare, government and financial services sectors. Gupta also is the author of two books on computer security, *Hack I.T.* and *Defend I.T.* He received a M.S. in Electrical Engineering in 1998 and was advised by **Professor John Baras** (ECE/ISR). ⊑s

Alumni: share your news with us!

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

studentNEWS


Stephan Koev

John Consoli

Stephan Koev is a recipient of the American Vacuum Society's (AVS) 2007 Graduate Research Award, a prestigious prize that draws nationwide competition each year. Stephan is an ECE Ph.D. student advised by Associate Professor **Reza Ghodssi** (ECE/ISR). Stephan is the third student from Ghodssi's MEMS Sensors and Actuators Lab to be honored with the award in five years; Nima Ghalichechian won the award in 2006 and Alireza Modafe won in 2002. Both Nima and Alireza also were advised by Dr. Ghodssi—who won this same award when he was a graduate student. Approximately 10 awards are given annually. The AVS award will be presented at the AVS 54th International Symposium in Seattle this October.

Ph.D. candidate **George Theodorakopoulos** and his advisor, Professor **John Baras** (ECE/ISR), were selected as winners of the 2007 IEEE Communications Society Leonard G. Abraham Prize in Communication Systems for their paper, "On Trust Models and Trust Evaluation Metrics for Ad Hoc Networks," *IEEE J. Selected Areas in Communications,* Vol. 24, No. 2, pp. 318–328, Feb. 2006.

The Abraham Prize is awarded annu-

ally for the best paper in communications systems published in the *IEEE Journal on Selected Areas in Communications*. The selection is based on quality, originality, utility, timeliness and clarity of presentation. George Theodorakopoulos graduated in May 2007 with a Ph.D. in Electrical and Computer Engineering. In the fall he joins the Communications Laboratory of the Ecole Polytechnique Federale de Lausanne (EPFL) as postdoctoral Research Fellow with Professor Jean Yves LeBoudec, an ISR Distinguished Lecturer this year.
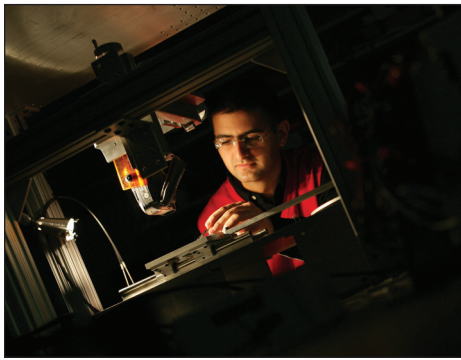
John Consoli

Nima Chalichechian

Nima Ghalichechian is the recipient of ISR's 2007 George Harhalakis Outstanding Systems Engineering Graduate Student Award. He was nominated by Associate Professor **Reza Ghodssi** (ECE/ISR), his faculty advisor. Nima's research focuses on the development of next generation power MEMS devices based on micro ball-bearing technology for miniature battery applications. It is an interdisciplinary project that involves design and modeling, materials characterization and process development as well as extensive device characterization and testing. Nima has designed, modeled and tested the world's first rotary micro-motor supported on micro ball bearings. As part of this work, he has also designed a creative MEMS fabrication process flow as well as a comprehensive material characterization experiment to test the electrical properties of the low-k dielectric materials used in this micro-machine. ☰S

Cukier finds hacks occur every 39 seconds

A study by ISR-affiliated assistant professor **Michel Cukier** (ME/Center for Risk and Reliability) is one of the first to quantify the near-constant rate of hacker attacks of computers connected to the Internet—every 39 seconds on average—and how non-secure usernames and passwords give attackers more chance of success.

"Our data provide quantifiable evidence that attacks are happening all the time," Cukier notes. "Our computers were attacked an average of 2,244 times a day."

The study profiled the behavior of "brute force" hackers, who use simple software-aided techniques to randomly attack large numbers of computers. Cukier says, "The vast majority of these attacks come from relatively unsophisticated hackers using automated 'dictionary scripts,' a type of software that runs through lists of common usernames and passwords and indiscriminately seeks out thousands of computers at a time, looking for vulnerabilities."

Cukier and two of his graduate students, **Daniel Ramsbrock** and **Robin Berthier**, set up weak security on four Linux computers with Internet access, then recorded what happened as the individual machines were attacked. "Root" was the top username guessed by dictionary scripts—attempted 12 times as often as the second-place "admin." Successful 'root' access would open the entire computer to the hacker, while 'admin' would grant access to somewhat lesser administrative privileges. Other top usernames in the hackers' scripts were "test," "guest," "info," "adm," "mysql," "user," "administrator" and "oracle." All should be avoided as usernames, Cukier advises.

The most common password-guessing ploy was to reenter or try variations of the username. Some 43 percent of all password-guessing attempts simply reentered the username. The username followed by "123" was the second most-tried choice. Other common passwords attempted included "123456," "password," "1234," "12345," "passwd," "123," "test," and "1." These findings support the warnings of security experts that a password should never be identical or even related to its associated username, Cukier says.

Once hackers gain access to a computer, they swiftly act to determine whether it could be of use to them. "Often they set up 'back doors'—undetected entrances into the computer that they control—so they can create 'botnets,' for profit or disreputable purposes." A botnet is a collection of compromised computers that are controlled by autonomous software robots answering to a hacker who manipulates the computers remotely. Botnets can act to perpetrate fraud or identity theft, disrupt other networks, and damage computer files, among other things.

This study provides solid statistical evidence that supports widely held beliefs about username/password vulnerability and post-compromise attacking behavior. Computer users should choose longer, more difficult and less obvious passwords with combinations of upper and lowercase letters and numbers that are not open to brute-force dictionary attacks.

The news about the study results has been carried by more than 60 different news organizations, including print, online, radio, television, and technology blogs. For a complete listing, see ISR's coverage at *www.isr.umd.edu/news/news_story.php?id=1872.* ☰S

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JáJá's PAWN software helps National Archives preserve federal records

ISR–affiliated Professor **Joseph Jájá** (UMIACS/ECE) is at the forefront of helping the National Archives preserve federal records. His team's Producer–Archive Workflow Network (PAWN) software, which the Archives funded, will enable agencies to submit records easily and with the assurance that they are being transmitted correctly. PAWN is a component of Jájá's larger ADAPT project, an approach to digital archiving and preservation technology.

The novel distributed, secure ingestion workflow technology enables users to remotely and securely transmit electronic data. PAWN is consistent with the Open Archival Information System model and is platform independent in its use of web/grid technologies. It has minimal client-side requirements and is easy to integrate with archival storage or data grid systems.

The "producer" module consists of a management/metadata server and an ingestion client. Based on a prior agreement, it provides data to an archive including initial arrangement, context and metadata.

The "archive" receives the data, validates the bitstreams and metadata, and sends an acknowledgement back to the producer. It also arranges the information into collections, specifies preservation policy, and publishes the bitstreams into a digital archive.

Eventually, all federal records will be tied into the Electronic Records Archive (ERA), which will be deployed in September when the Patent and Trademark Office, Bureau of Labor Statistics, Navy Oceanographic Office and National Nuclear Security Administration test its effectiveness.

You can view a PowerPoint presentation about PAWN at *umiacs.umd. edu/research/adapt/papers/erpanet.ppt.* ΞS

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A. JAMES CLARK
SCHOOL OF ENGINEERING

The Institute for Systems Research
University of Maryland
College Park, MD 20742–3311

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