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SYSTEM SOLUTIONS
THE INSTITUTE FOR SYSTEMS RESEARCH

The Institute for Systems Research

INSIDE

Rubloff leads new M-CINSE nanotech center

Professor **Gary W. Rubloff** (MSE/ISR) is the founding director of the new Maryland Center for Integrated Nano Science and Engineering (M-CINSE), a partnership among engineering, the physical sciences, and the life sciences at the University of Maryland.

M-CINSE brings together the university's nano science and engineering community, highly cross-disciplinary researchers who cross conventional lines of organization and discipline. It is housed within the Institute for Research in Electronics and Applied Physics (IREAP).

Rubloff, a former director of ISR, says M-CINSE is driven by two fundamental goals: "First, it emphasizes close integration of science and engineering to provide an optimum engine for technology, products, and fundamental discoveries. Second, it seeks to enhance the coherence and effectiveness of the Maryland nano community."

M-CINSE will help the university contribute to the nanoscience field at a very high level. In addition, the perspective and connectivity of the M-CINSE community will offer students a rich, cross-disciplinary, and relevant experience in preparing for nano-related science and engineering careers.

ISR faculty participating in M-CINSE include Rubloff; Associate Professor **Ray Adomaitis** (ChE/ISR); Assistant Professors **Benjamin Shapiro** (ME/ISR), **Reza Ghodssi** (ECE/ISR) and **Pamela Abshire** (ECE/ISR); and ISR-affiliated Professors **Christopher Davis** (ECE), **Neil Goldsman** (ECE) and Assistant Professor **Elias Balaras** (ME).

Professor Rubloff on site at the new Jeong H. Kim Building, which will house M-CINSE's Keck Laboratory for Combinatorial Nanosynthesis and Multiscale Characterization.

Rubloff notes that Maryland's nano community "includes faculty with particular interest in technology transfer and related economic impact who are eager to pursue partnerships with commercial and defense enterprises and

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director's CORNER

This is a very exciting time for the Institute for Systems Research, in large part because of the wide recognition of the central role that systems methodologies must play in solving today's technological challenges. We are very fortunate to have a tradition at the University of Maryland that encourages interdisciplinary research, and to have an outstanding and energetic pool of faculty who share a commitment to pursuing important collaborative research of the highest quality.

Opportunities abound for ISR to continue to make important contributions through its research, education and outreach. We are at the forefront in many timely problem areas, and are investigating new opportunities in areas such as systems biology, software-enabled systems engineering, and RFID sensor networks.

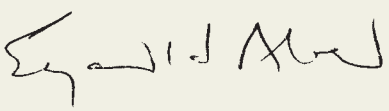
This issue of *System Solutions* contains several examples of important and challenging research projects being carried out in the ISR. These interdisciplinary projects bring together researchers with complementary expertise to address important and timely problems. Our faculty are being called on to take leading roles in the investigation of crucial new areas. For example, our cover story is about Professor **Gary Rubloff's** (MSE/ISR) new role as founding director of the Maryland Center for Integrated Nano Science and Engineering.

One of the best examples of a strong interdisciplinary research team in the ISR is the neuroscience group, featured in an article starting on page 6. Faculty participating in our neuroscience activities come from several departments on campus, and have very diverse backgrounds. Yet, they work together as a group, pursuing joint research and often co-advising graduate students.

Many of our faculty, students, staff and alumni have made major achievements since the last issue of *System Solutions*. Some of these are mentioned in this issue, and others can be found through our website, *www.isr.umd.edu,* which reports our most current news and also provides links to our news archives. Of particular note is the naming of ISR alumna **Naomi Leonard** (Ph.D., ECE, 1994) as one of 23 MacArthur Fellows for 2004—see page 9.

We are very proud of our almuni, many of whom have distinguished themselves in their research, teaching and service to society. Some of our alumni have even made the time to actively work for humanitarian causes, such as ISR Research Associate **Dr. Priya Ranjan,** who was recently featured along with other students and alumni on Washington's WUSA Channel 9 TV news, in the *Washington Post,* and other media outlets for his work in raising funds to support relief efforts for those affected by the recent tragic tsunami. They have collected over $1.5 million as this newsletter goes to press.

Best wishes to you, our friends, colleagues and alumni, for a happy, prosperous and safe 2005.



Rubloff leading M-CINSE

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generate intellectual property."

One major part of M-CINSE is the new Keck Laboratory for Combinatorial Nanosynthesis and Multiscale Characterization, which will be housed in the new Jeong H. Kim Engineering Building, opening in 2005.

Conceived by Rubloff, **Ichiro Takeuchi** (MSE) and **Ellen Williams** (Physics), the Keck Laboratory will be a centerpiece for pioneering research in combinatorial materials science, scanning nanoprobes, and highly controlled materials synthesis. This will enable new insights into the behavior of nanoscale materials. It is funded by a $750,000 award from the W. M. Keck Foundation of Los Angeles.

The experimental platform will have unprecedented capabilities for rapid exploration of advanced complex smart materials and memory devices, as well as systematic investigation of their physical mechanisms. Laser molecular beam epitaxial growth under ultraclean conditions will enable control and lattice engineering of materials at the atomic level, while in-situ patterning of the materials will deliver combinatorial libraries for rapid materials discovery and development.

A novel microscope will measure the performance of materials through spin resonance microwave microscopy of the nanoscale and surface structure at the atomic scale. The chemical and structural properties of the combinatorial material libraries will be monitored during production using surface analytical techniques; then the samples will be transferred to the microscope under ultraclean conditions. This will enable researchers to establish clear correlations and deep understanding of how the architecture of materials at the nanoscale determines their properties and performance.

You can learn more about M-CINSE, its faculty and research, and the Keck Laboratory online at *www.nanocenter.umd.edu.*

major AWARDS

Shapiro, Horiuchi, Balaras win CAREER awards

Three ISR faculty members have been awarded National Science Foundation Faculty Early Career Development (CAREER) awards. The NSF 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.

Assistant Professor **Benjamin Shapiro** (AE/ISR) won a CAREER Award for his work on "Feedback Control of Micro-Fluidic Packets and the Bio-Particles within Them."

Assistant Professor **Timothy Horiuchi** (ECE/ISR) was given a CAREER Award for his work on "Adaptive Neuromorphic VLSI for Improving Accuracy and Precision: Modeling Attention for Bat Echolocation."

ISR-affiliated Assistant Professor **Elias Balaras** (ME) won a CAREER Award for his work on "Large-Eddy Simulation of Turbulent Flows with Dynamically Moving Boundaries."

Moss is PI for NSF/NIH biosonar grant

Professor **Cynthia Moss** (Psychology/ISR) is the principal investigator for a new four-year, $1.3 million NSF/NIH grant, "Innovative Technologies Inspired by Biosonar." Co-PIs for this grant are Professor **P.S. Krishnaprasad** (ECE/ISR), Professor **Shihab Shamma** (ECE/ISR), Assistant Professor **Timothy Horiuchi** (ECE/ISR), and ISR-affiliated Assistant Professor **Jonathan Simon** (ECE/Biology). The project aims to advance understanding of the transformation of sensory information to motor commands for adaptive behaviors such as tracking, reaching, grasping and steering around obstacles in the natural environment.

A more complete understanding of the computations supporting these vital functions of the nervous system will facilitate treatment and rehabilitation when they fail to develop normally or break down through disease. The echolocating bat will be used as a model system because it exhibits rich but well-defined adaptive motor patterns that indicate changing behavioral states. This interdisciplinary project brings together biology, neural recording telemetry, and control systems in novel and important ways.

This grant in the NSF/NIH Collaborative Research in Computational Neuroscience (CRCNS) program is funded by the National Institute of Biomedical Imaging and Bioengineering.

Two MIPS projects for Liu

The Maryland Industrial Partnerships (MIPS) program has announced its latest round of contract awards, and Professor **K.J. Ray Liu** (ECE/ISR) is associated with two of them.

He is continuing his work with InTank, Inc., of Laurel, Md., on the MIPS project, "Ultrasonic Nondestructive Inspection of Tanks." This project is developing an effective and efficient ultrasonic testing system for use in robots that inspect commercial storage tanks such as gasoline, fuel oil, and chemicals.

Liu also is working with Maryland Semiconductor, Inc., Clarksburg, Md., on "Wireless USB Broadband Connectivity," a new project that will develop high-speed, wireless universal serial bus (USB) hardware and software to interconnect office devices at data rates of 55 to 480 megabits per second.

Ghodssi: NSF grant for optical filters and switches

Assistant Professor **Reza Ghodssi** (ECE/ISR) is the principal investigator for a new three-year, $210,000 National Science Foundation grant for InP-based MEMS-tunable Optical Filters and Switches. Madhumita Datta, research associate in the MEMS Sensors and Actuators Lab, is the co-PI. The objective of the project is to develop and test wavelength-selective widely tunable (1250-1650 nm) resonant microcavity filters and switches by on-chip electrostatic micro-electro-mechanical actuation of indium phosphide (InP) waveguides and highly reflective monolithic horizontal mirrors, for broadband optical networks.

ISR faculty part of micro hovering air vehicles MURI

Three ISR faculty members are part of a new three-year (with option for two more), $3 million Multidisciplinary University Research Initiative (MURI) award from the Department of Defense. Associate Professor **S.K. Gupta** (ME/ISR), Assistant Professor **Reza Ghodssi** (ECE/ISR) and Assistant Professor **Benjamin Shapiro** (AE/ISR) will be working on "Micro Hovering Air Vehicles: Revolutionary Concepts and Navigation Advancements."

This award focuses on the development of revolutionary concepts and navigation advancements in the emerging research area of micro hovering air vehicles. The principal investigator is Professor **Inderjit Chopra** (AE).

Davis awarded DURIP for optical and radio frequencies testbed

ISR-affiliated Professor **Christopher Davis** (ECE) received a $291,047 DURIP (Defense University Research Instrumentation Program) for "Optical and Radio Frequency Communications Testbed for Scalable Networks."

continued on page 4...

majorAWARDS

Horiuchi is PI for AFSOR grant

Assistant Professor **Timothy Horiuchi** (ECE/ISR) is the principal investigator for a new Air Force Office of Scientific Research (AFOSR) grant. Professor **P.S. Krishnaprasad** (ECE/ISR) is co-PI. The three-year, $286,000 grant is for "Neuromorphic VSLI-Based Bat Echolocation for Micro-Aerial Vehicle Guidance." This grant will fund research in the development of VLSI implementations of neural processing found in the brainstem and midbrain of the echolocating bat. The chips will provide real-time, low-power sensing and will be tested on flying micro-aerial vehicles for collision avoidance and maintaining elevation in forest-like environments.

Shamma receives NIH grant for auditory cortex work

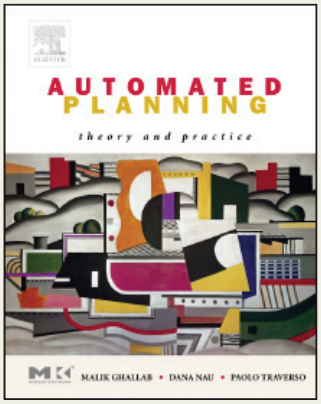
Shihab Shamma (ECE/ISR) is the principal investigator for a new five-year, $1.25 million grant from the National Institutes of Health. "Spectro-Temporal Plasticity in Primary Auditory Cortex" is sponsored by NIH's National Institute on Deafness and other Communication Disorders. The co-PI is ISR Assistant Research Scientist **Jonathan Fritz**.

Auditory experience can cause significant and continuous reorganization and receptive field plasticity in the primary auditory cortex. Auditory cortical cells may undergo rapid, short-term, and context-dependent changes of their receptive field properties when an animal is engaged in different auditory behavioral tasks. This kind of plasticity would likely involve a selective functional reconfiguring of the underlying cortical circuitry to sculpt the most effective receptive field for accomplishing the auditory task. Shamma's research will explore this hypothesis. ES

facultyNEWS

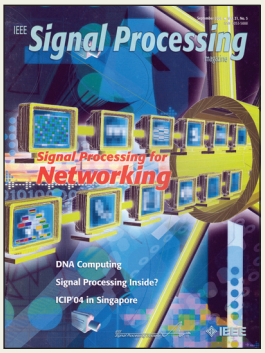
Professor **Michael Ball** (Robert H. Smith School of Business/ISR) has been named a Fellow of INFORMS (Institute for Operations Research and the Management Sciences). INFORMS is Dr. Ball's principal professional society.

Assistant Professor **Benjamin Shapiro** (AE/ISR) and his students **Satej Chaudhary, Michael Daniel Armana** and **Roland Probst** were finalists in the University of Maryland's 17th annual Invention of the Year awards, sponsored by the Office of Technology Commercialization. Their invention, "Arbitrary and Simultaneous Control of Multiple Particles in Micro-Fluidic Systems," uses microscopic cameras and fiber optic systems in conjunction with sophisticated computer software to visually identify individual particles in a fluid. The scheme also calculates the precise movement of tiny actuators to direct fluid flow within the microfluidic system on a particle-by-particle basis.



Professor **Dana S. Nau** (CS/ISR) is one of three authors of a new book, *Automated Planning,* published by Morgan Kaufman, a division of Elsevier. The book is written for researchers, practitioners and graduate students in artificial intelligence, robotics, and operations research. Nau's co-authors are Malik Ghallab, LAAS-CNRS; and Paolo Traverso, ITC-IRST. It is a comprehensive, up-to-date resource on both the theory and practice of automated planning. It goes well beyond classical planning, to include temporal planning, resource scheduling, planning under uncertainty, and modern techniques for plan generation, such as task decomposition, propositional satisfiability, constraint satisfaction, and model checking. Learn more at *www.laas.fr/planning/*.

Professor **Carlos Berenstein** (Math/ISR) was honored on his 60th birthday at "A Celebration of Carlos Berenstein's Mathematics: Harmonic Analysis, Signal Processing and Complexity," hosted by George Mason University. ISR's **P.S. Krishnaprasad** (ECE/ISR) and **John S. Baras** (ECE/ISR), as well as Dr. Berenstein himself, were among the speakers.



Professor **K.J. Ray Liu** (ECE/ISR) is the editor-in-chief of *IEEE Signal Processing Magazine*. The magazine now ranks first among 205 electrical and electronics journals in citation impact (up from second place last year). In addition, it is the most-read journal in the signal processing community, with more than 25,000 subscribers. Dr. Liu also won the 2004 EURASIP Meritorious Service Award for leadership for establishing *EURASIP Journal on Applied Signal Processing* as a leading journal in the field. EURASIP is the European Association for Signal, Speech and Image Processing.

Professor **Nicholas Roussopoulos** now holds a joint appointment with ISR and the Department of Computer Science. He is a former ISR-affiliated faculty member. In addition, former ISR postdoctoral researcher **Jonathan Fritz** is now an ISR Assistant Research Scientist.

For several months this year, ISR-affiliated

Dave Akin and the Ranger robot

Associate Professor **Dave Akin** (AE/ISR) and his Space Systems Laboratory's (SSL) Ranger robot were in the running to win the contract for Hubble Space Telescope repair. While NASA ultimately announced its intent to use a Canadian robot named Dextre, the SSL is now helping evaluate Dextre by running underwater simulations for NASA Goddard, working out the procedures this robot will use to replace Hubble's instruments.

Professor **Cynthia Moss** (Psychology/ISR) became the director of the University of Maryland's Neuroscience and Cognitive Science (NACS) program this summer. NACS is a cross-campus Ph.D. program that includes affiliate laboratories at the National Institutes of Health (NIH). NACS offers training in systems neuroscience, computational neuroscience and cognitive science, with an emphasis on work at the interface of these disciplines. NACS became an official degree-granting program in 1996 under the directorship of another ISR faculty member, Professor **Avis Cohen** (Biology/ISR).

Moss and her graduate student **Kaushik Ghose** won first place in the multimedia non-interactive division of the 2004 Science and Engineering Visualization Challenge. The challenge is sponsored by the National Science Foundation and *Science* magazine. View the presentation at: *www.bsos.umd.edu/psyc/batlab/headaimmovies/nsf_challenge/nsf4.wmv.*

The A. James Clark School of Engineering presented Associate Professor **Guangming Zhang** (ME/ISR) with the 2004 Poole and Kent Outstanding Teaching Award for Senior Faculty. Dr. Zhang won the award for the impact he has made to education and curriculum in the college.

ISR's Coordinator for Educational Programs **Lee Harper** had a paper accepted for presentation at the American Society for Engineering Education's Annual Conference in Salt Lake City, this summer. Harper's paper was titled, "The Social Consequences of Design: Requirements and Trade-Offs in Large-Scale Engineering Projects."

Close to 200 research posters from last March's TECH 2004 event are now available online in PDF format for you to view, download and print out. You can also access posters from the 2003 and 2002 events. TECH 2004 showcased the research of students and faculty from ISR, the Computer Science Department, the Electrical and Computer Engineering Department, and the Institute for Advanced Computer Studies (UMIACS). View them at *www.tech2004.umd.edu/posters_demos_04.html.*

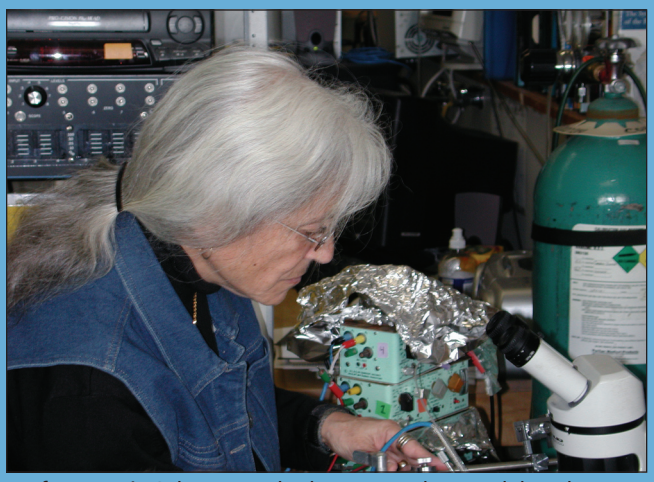
ISR-affiliated Professor **James Hendler** (CS) recently discussed the future of IT in the war on terrorism at the National Press Club. *The National Journal,* C-SPAN, and *Government Computer News,* all picked up the story. Hendler also was interviewed on local news radio station WTOP and in *The Jerusalem Post* about the Semantic Web. Hendler says new technological devices will enable information on the Internet to be more secure. You can view a site that is completely powered by Semantic Web technologies at *www.mindswap.org.*

ISR held its annual awards ceremony on May 18. The Outstanding Faculty Award was given to Assistant Professor **Timothy Horiuchi** (ECE/ISR). He was chosen for the award by ISR's Strategic Advisory Committee. The George Harhalakis Outstanding Systems Engineering Graduate Student Award went to **Kaushik Ghose,** who is shown in the above photo receiving the award from ISR Director **Eyad Abed**. Professor **Cynthia Moss** (Psychology/ISR) nominated him for the award. ISR Assistant Director for External Affairs **Jeff Coriale** won the Outstanding Staff Award.

The ISR neuroscience group: cross-disciplinary collaboration at its best

ISR is home to a group of faculty members from diverse disciplines who conduct research in a field called "neuromorphic engineering."

Neuromorphic engineers build machines that mimic biological sensory processes and process information similarly to the brain. They look at neurological structures such as the retina, the auditory cortex, and the spinal cord, then devise chips that mimic neurons and brain chemistry. Such biological structures are very efficient at extracting information from the environment. The neuromorphic approach seeks to capitalize on this, creating technology superior in size, speed and low power consumption. Partly because of their speed, such systems use feedback extremely well. This allows neuromorphically designed machines to be far more responsive to their environment than conventional robots.



Professor Avis Cohen uses the lamprey as her model as she investigates spinal cord regeneration.

Neuromorphic bat research

Assistant Professor **Timothy Horiuchi** (ECE/ISR) uses the example of echolocating bats to understand how biological systems operate so power efficiently and how adaptation and learning are integrated into the brain. Although bats seem very different from humans, their brains detect and analyze sounds much the same way humans do. The differences in auditory behavior between bats and humans are reflected in brain structures, giving us a clue about how brains process sound.

Professor Cindy Moss with one of the brown bats used in her echolocation research.

This knowledge could help open the door to autonomous robots that navigate by sound as well as devices that assist humans or extend human perception by "hearing."

Horiuchi's Computational Sensorimotor Systems Laboratory focuses on bat echolocation modeling, very-large-scale-integration (VLSI) implementation, and neural recording combined with radio telemetry.

Horiuchi and Professor **Cynthia Moss** (Psychology/ISR) are designing electronic implementations of neural systems for real-time robotic systems. They use both physical models and software simulation to understand how the flow and processing of echolocation information drives behavior.

The group also is interested in developing low-power sensory and motor systems that could benefit robotics. They are developing VLSI models of the bat cochlea, the echo-direction sensitive cells of the lateral superior olive, the echo delay-tuned cells of the inferior colliculus, and the sensorimotor cells of the superior colliculus. The group also studies their roles in controlling behavior.

In another collaborative effort, Moss and Horiuchi are developing telemetry devices to measure sonar vocalizations, extracellular neural responses, and EMG potentials in flight. These will be transmitted via radio signals to a video-synchronized multi-channel data acquisition system.

Moss is enthusiastic about the environment ISR provides her for collaborative work. "I have colleagues, a stimulating intellectual climate, and support," she says.

The bat research crosses many disciplinary boundaries, bringing a systems view to how bats detect and use sound to understand their world. This has not gone unnoticed by the science, health and defense communities.

Horiuchi and Moss recently received a $1.6 million grant from NIH's Division of Neuroscience and Basic Behavioral Science for their work in "Dynamic Sensorimotor Control for Spatial Orientation." The project will expand understanding of how mammals process and integrate auditory information with their movements, adapting

as they move through their environments.

Horiuchi recently received an NSF CAREER Award *(see page 4)* for his work on "Adaptive Neuromorphic VLSI for Improving Accuracy and Precision: Modeling Attention for Bat Echolocation." Horiuchi and Professor **P.S. Krishnaprasad** (ECE/ISR) received a grant from the Air Force Office of Scientific Research *(see page 5)* for research in VLSI implementation of neural processing found in bats' brainstems and midbrains. Chips based on this research will provide real-time, low-power sensing in flying micro-aerial vehicles for collision avoidance and maintaining elevation in forest-like environments.

CRCNS: working together

The recent $1.3 million CRCNS NSF/NIH grant, "Innovative Technologies Inspired by Biosonar" *(see page 4)* is a prime example of ISR faculty collaborating to bring added value to research. Moss is the project's principal investigator. She is joined by Krishnaprasad, Horiuchi, Professor **Shihab Shamma** (ECE/ISR) and ISR-affiliated Assistant Professor **Jonathan Simon** (ECE/Biology).

Moss explains the synergy among the faculty members. "Krishna and Jonathan are the control guys," she says. "Timmer (Horiuchi) builds the chips and does modeling, but he's strong in biology, too. Shihab and Jonathan analyze the neural data and do modeling. I work on the biological side of things, working directly with the systems."

The CRCNS project will integrate miniaturized radio telemetry recordings, advanced signal processing, control systems modeling, adaptive behavior studies and neurophysiology. It aims to expand understanding of how sensory information is transferred to motor commands for adaptive behaviors such as tracking, reaching, grasping and steering around obstacles.

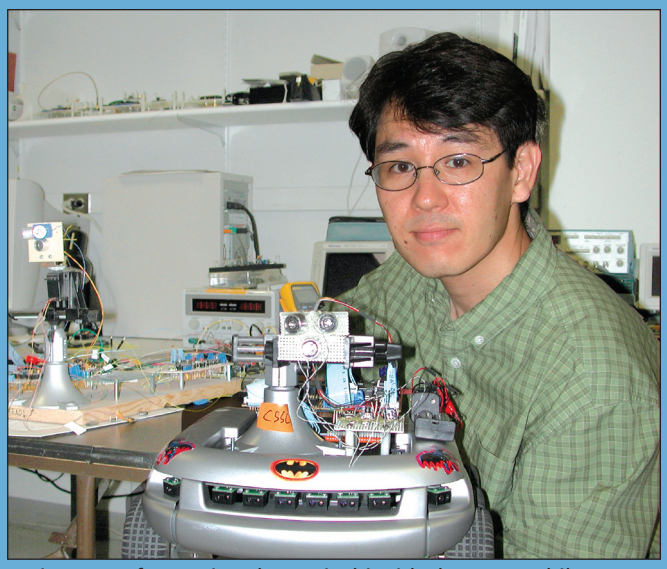
Moss's Auditory Neuroethology Lab has developed technology to track the direction, velocity and curvature of the bat's flight path as it negotiates obstacles and pursues insect prey on the wing, while simultaneously monitoring where the animal is looking by measuring its sonar beam aim.

This platform may revolutionize applications in robotics, neural prosthesis design and neurobiological studies.

For example, if a lightweight neural telemetry device were developed that could record multiple channels in freely moving animals, it would greatly help researchers who use small animals as model systems for research in learning, memory, sensation and motor control. In turn, this new data could stimulate innovations in neurology, including the human health implications of central nervous system injury and disease.

The computational power of the bat's brain for rapidly processing acoustic information and driving adaptive motor commands is astonishing and sets a standard for engineers to build devices of similar size (less than 1 gram) and capacity.

A wide range of biomedical applications are possible, including implantable neural prostheses, ultra-lightweight low power sensors and controllers, medical tool design, and sonar-based assistive medical devices.



Assistant Professor Timothy Horiuchi with the "Batmobile," a robotic vehicle incorporating technology based on his research.

More activities

Shihab Shamma (ECE/ISR) is the principal investigator for a new five-year, $1.25 million grant, "Spectro-Temporal Plasticity in Primary Auditory Cortex" *(see page 5),* sponsored by NIH's National Institute on Deafness and other Communication Disorders. The co-PI is **Jonathan Fritz**, an ISR assistant research scientist.

These faculty are also active in the Institute for Neuromorphic Engineering, a non-profit research coordination network developing auditory, robotics, and motor control tools. Professor **Avis Cohen** (Biology/ISR) says INE encompasses smart systems, both wheeled and legged robotics, auditory, visual and voice recognition devices. INE also facilitates the Neuromorphic Engineering Workshop in Telluride, Colo., for three weeks each summer. The National Science Foundation-funded event draws more than 60 researchers.

ISR faculty with neuromorphic interests

Joint appointments
Avis Cohen (Biology/ISR)
P.S. Krishnaprasad (ECE/ISR)
Cindy Moss (Psychology/ISR)
Shihab Shamma (ECE/ISR)
Pamela Abshire (ECE/ISR)
Timothy Horiuchi (ECE/ISR)

Affiliated faculty
Ralph Etienne-Cummings (Johns Hopkins)
Jonathan Simon (ECE/Biology)

Assistant Research Scientist
Jonathan Fritz

Naomi Leonard receives famed MacArthur Foundation 'genius' grant

ISR alum **Naomi Leonard,** who has been making waves in underwater robotics research, was named one of 23 MacArthur Fellows for 2004 in October. The award, sponsored by the John D. and Catherine T. MacArthur Foundation, is a $500,000, "no-strings-attached" grant that underscores the importance of the creative individual in society. Recipients are selected for their originality, creativity, and the potential to do more in the future. The award is sometimes referred to in the media as "the genius grant."

Grants are given to people from all walks of life. Leonard is described on the MacArthur web site as a "marine roboticist building multiple, miniature, autonomous underwater vehicles that mimic the behavior of schooling fish."

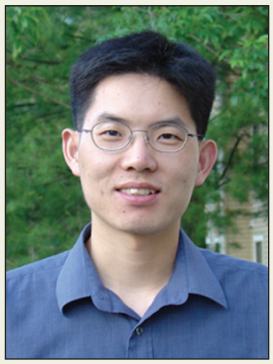
Leonard is a professor of Mechanical and Aerospace Engineering at Princeton University. She is a 1994 Electrical Engineering Ph.D. Her advisor was Professor **P.S. Krishnaprasad** (ECE/ISR). She wrote a book with ISR-affiliated Professor Bill Levine (ECE) in 1992 as a student, *Using MATLAB to Analyze and Design Control Systems.* This fall, Leonard hired recent ISR grad Fumin Zhang as a postdoctoral researcher.

This fall, she was named the principal investigator for a Department of Defense MURI for "Optimal Asset Distribution for Environmental Assessment and Forecasting Based on Observations, Adaptive Sampling, and Numerical Predictions."

Read our profile of Leonard from this spring's *System Solutions* online at *www.isr.umd.edu/ISR/publications/newsletter/sswi03/Naomi.html.* ≡S

ISR alum **Jie Chen** (Ph.D.1998), an assistant professor in Brown University's Electrical Sciences and Computer Engineering Department, has been named a Distinguished Lecturer by IEEE's Circuits and Systems Society. His term lasts through December 2005. He lectures on "Nanoscale Device Modeling and its Fault-Tolerance Mesoscopic System Design" and "Joint Cross-Layer Design for Wireless QoS Content Delivery."

Jie Chen heads the Brown BINARY Lab (Biology, Information science and Nanotechnology Applications and Research laboratorY). His Ph.D. advisor was Professor **K.J. Ray Liu** (ECE/ISR).



ISR Research Associate **Xiaobo Tan** has joined Michigan State University's Electrical and Computer Engineering Department as Assistant Professor. Xiaobo's Ph.D. thesis focused on modeling and control of hysteresis in smart materials. His faculty advisors were **John S. Baras** (ECE/ISR) and **P.S. Krishnaprasad** (ECE/ISR).

Xiaobo was an ISR Systems Fellow from 1998-2002 and a postdoc from 2002–2004, working with Dr. Baras on networked control systems and **Reza Ghodssi** (ECE/ISR) on the characterization and modeling of frictional behaviors of linear microball bearings. He will continue research in modeling and control of smart materials, microsystems and networked systems.

ISR alum **Hesham El-Gamal,** now on the faculty of the Electrical and Computer Engineering Department at Ohio State, is the recipient of a 2004 National Science Foundation CAREER Award for "MIMO Fading in Links, Cells, and Networks: Coding and Information Theoretic Challenges."

His research will focus on antenna diversity techniques, which have received considerable attention due to the significant theoretic information gains promised for multi-input-multi-output (MIMO) fading channels. Hesham hopes to develop a unified algebraic coding theory for point-to-point MIMO fading channels. This will bridge different branches in algebra and space-time coding. ≡S

REU students' simulation models help county government evaluate mass vaccination clinics

The 2004 class of REU students

Associate Professor **Jeffrey Herrmann** (ME/ISR) and seven Research Experiences for Undergraduates (REU) students assisted with a Montgomery County, Md., mass vaccination drill in June.

The Montgomery County Department of Health and Human Services practiced a emergency procedure for mass vaccination, using a local high school as a staging area. The event was meant to simulate procedures the county might need to use in the event of a virus outbreak, epidemic, or biological terrorism attack. The county practiced procedures that have been mostly theoretical until now.

Nearly 500 "patients," played by community volunteers, were bused in from staging areas, simulating emergency transportation procedures. Then they registered with health workers and watched an educational video about vaccinations.

The REU students staffed six tables with automatic timestamp devices. Each patient going through the clinic had a form that was stamped six times. Herrmann and the students used the data to report on the clinic's performance and simulation model. Tyson Cook, an REU student working directly for Dr. Herrmann, then created simulation models of the clinic.

ISR's REU program (*www.isr.umd.edu/ISR/education/REU*) brings together talented undergraduates from across the country to participate in focused, 10- to 12-week summer research experiences with individual ISR faculty members. The program is funded by the National Science Foundation. You can read about the mass vaccination clinic online at *www.gazette.net/200426/takoma/news/222678-1.html*.

ISR team wins the university's Business Plan Competition

MacroPhage Networks has won the graduate student category of the University of Maryland's 2004 Business Plan Competition. The team consists of **Mehdi Kalantari** (right), a Ph.D. candidate in ECE and ISR; **Mehdi Alasti,** a 2001 Ph.D. from ECE and ISR; and ISR-affiliated Professor **Mark Shayman** (ECE), who is CTO and interim CEO.

The company offers a novel technology to identify and eliminate Distributed Denial of Service (DDoS) attacks, serious threats to current and next generation networks. MacroPhage will provide a distributed immunity system for the Internet, composed of cells installed at vulnerable points such as edge routers and firewalls. The cells monitor traffic through the network and perform a test that detects the attack flows.

The test algorithm is based on "Code division multiple access Aggregate Perturbation method" (CAP), a patented technology. This state-of-the-art algorithm detects attack traffic almost immediately (about 30 seconds after the start of an attack) and provides an opportunity for the ISP to suppress the illegal flows proactively, before the attack traffic turns into a flood that causes congestion or denial of service. MacroPhage's immunity system is an evolutionary approach that does not require changes in architecture, hardware, software or network protocols. It can be deployed incrementally to provide safety and security for Internet servers and hosts.

NEXTOR visiting student wins award in France

Philippe Montebello, who this spring completed a stay as a NEXTOR visiting exchange student from Ecole Nationale de L'Aviation Civile (ENAC) in Toulouse, France, has received the City of Toulouse Award. The award is given to Toulouse students who have spent part of their academic year abroad in an internationally recognized university, and who have been ambassadors of the city's academic and research community.

Philippe's thesis, based on his work on advanced arrival slot-trading mechanisms with NEXTOR, was ranked highest in his class at ENAC. He will be employed within the French civil aviation administration.

NEXTOR is the National Center for Excellence for Aviation Operations Research. Established by the Federal Aviation Administration in 1996, NEXTOR's consortium of five universities advances new ideas and paradigms for aviation operations. NEXTOR participates in a student exchange program with ENAC. Professor

continued on page 10...

Michael Ball (ISR/Business) leads the University of Maryland's participation in NEXTOR.

ISR-affiliated Associate Professor **Dave Akin's** (AE) ENAE 484 team project, "MORPHLAB: Modular Roving Planetary Habitat, Laboratory, and Base" tied for first place (undergraduate) at the NASA Revolutionary Aerospace Systems Concept—Academic Liaison (RASC-AL) competition in Cocoa Beach last spring.

Brian Morgan, a graduate student in the MEMS Sensors and Actuators Laboratory, received a 2004-2005 ARCS Scholarship. His research focuses on novel three-dimensional silicon MEMS microfabrication technology. The awards are sponsored by the Metropolitan Washington Chapter of the ARCS (Achievement Rewards for College Scientists) Foundation, Inc. He is advised by Assistant Professor **Reza Ghodssi** (ECE/ISR).

Grad student **George Theodorakopoulos** and his faculty advisor Professor **John S. Baras** (ECE/ISR) won the best paper award at the ACM Workshop on Wireless Security for "Trust Evaluation in Ad-Hoc Networks." The paper presents a novel application of a mathematical framework (semiring theory) to the evaluation of trust evidence between network users. The award was given October 1 at the workshop in Philadelphia. ≡S

Adomaitis, Milner guide Gemstone undergraduate honors teams

The ChemSense team at their thesis defense, with the Metro station model they constructed on the table in the foreground.

Two ISR faculty recently completed mentoring gifted undergraduates in the Gemstone honors program, where students from different disciplines work together on a four-year research project with both technological and societal implications.

Associate Professor **Ray Adomaitis** (ChE/ISR) guided the ChemSense Gas Sensors Networking group, whose thesis research assessed the value of gas sensor networks in protecting public spaces.

The work focused on sensors installed in DC-area Metro stations to help protect them from chemical or toxic agent attacks. As part of their research, the students constructed a model of the Gallery Place/Chinatown station, and fit it with four sensors. They ran experiments, fine-tuned networking electronics, and compared experimental data with simulator predictions.

ISR Senior Research Scientist **Stuart Milner** advised the Innovations Gemstone team, which designed two consumer-oriented items. The lightweight, portable and inexpensive miniature dryer the team developed can quickly dry single items of clothing. The dryer takes advantage of natural convection and has no moving parts. Their computer interface for handheld devices uses zooming animation and outperformed Windows Mobile 2003 in user tests.

ISR faculty regularly serve as mentors for Gemstone. Associate Professor **David Lovell** (CEE/ISR) mentors the 2005 SmartRoads team, which seeks to improve highway systems. Assistant Professor **Dimitrios Hristu** (ME/ISR) mentors the 2006 Advancing Ignition Interlock team, looking to make more affordable and effective devices that prevent inebriated people from driving. ≡S

Undergrad Roberts wins Hertz Foundation Award

Spring 2004 grad **Jennifer Roberts** won both the NSF Graduate Research Fellowship Award and the Hertz Foundation award for graduate engineering study at the Massachusetts Institute of Technology. These awards will fully support her graduate education through the Ph.D. level.

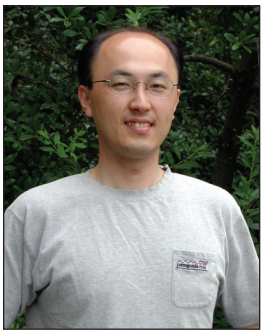
The Hertz Foundation award was granted to only 19 seniors nationwide this year. It focuses on engineering and physical sciences, and is oriented towards students who are interested in applied research to help humanity within the next 50 years.

Hertz is also interested in students who are public service minded and want to give back to the community. Jennifer was well known for her work on behalf of mental health. She founded Active Minds at Maryland, organizing students for mental health advocacy at the university.

As an undergrad in electrical and computer engineering, Jennifer worked in Professor **Shihab Shamma's** (ECE/ISR) Neural Systems Lab, learning about neural engineering. She also worked with Professor **John S. Baras** (ECE/ISR). ≡S

Honda Visiting Scientist news

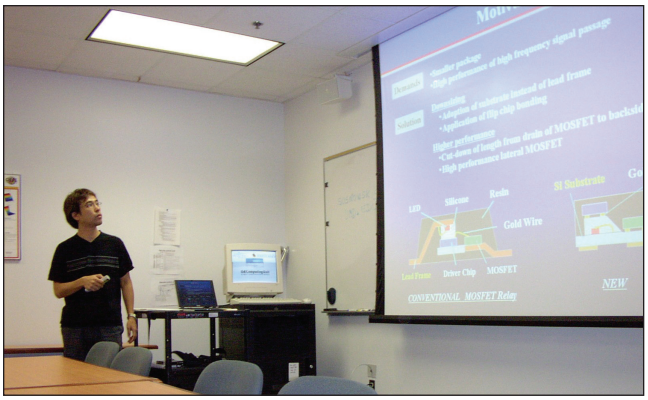
In July, ISR welcomed **Mr. Masaaki Nagashima,** our newest Visiting Scientist from Honda R&D, Japan. Mr. Nagashima is an engineer who is conducting research with ISR-affiliated Professor **William Levine** (ECE) on automotive exhaust emission control and CO_2 control during his 12-month visit at ISR as part of the ISR-Honda Visiting Scientist Program.



Mr. Morimichi Nishigaki, the 2003–2004 visiting scientist from Honda R&D, gave his final presentation on July 22. His topic was "Ego-Motion Estimation Using Fewer Image Feature Points," based on his research with Professor **Yiannis Aloimonos** (CS) on 3-D image reconstruction for video images. In the spring, he gave a seminar on "The Future of the Adaptive Cruise Control System." Mr. Nishigaki is an engineer interested in researching obstacle recognition using stereo images, a technology that could improve drive support and collision prevention systems for vehicles.

Toshiba Visiting Scientist news

ISR is currently hosting **Mr. Tomohiro Iguchi,** a researcher from Toshiba Corporation in Japan. He joined the ISR-Toshiba Visiting Scientists Program to work with Assistant Professor **Reza Ghodssi** (ECE/ISR) and Professor **Gottlieb Oehrlein** (MSE) on microelectronics process technology for advanced small optical modules using 3D silicon interposers and IC stacking technology.



Toshiba's Taizo Tomioka giving his final research summary before he returned to Toshiba in Japan on Oct. 5, 2004.

Strategic Advisory Council meets

The ISR Strategic Advisory Council met on June 25 on campus. This group of industry, academic and government leaders provides evaluation and guidance to ISR on its research directions, educational programs, and management.

Spring 2005 Distinguished Lecturers

We invite you to join us for our 2005 Distinguished Lecturers Series! Details are available at *www.isr.umd.edu/ISR/about/dls.html*.

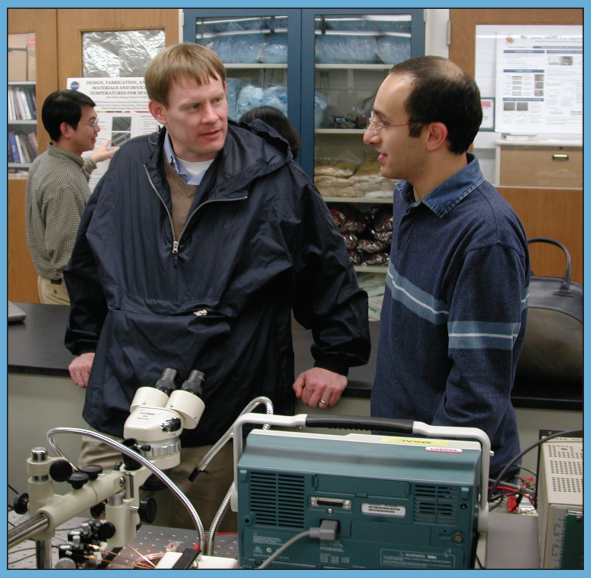
March 9, 5:00 p.m. Dr. Eric D. Green, the Scientific Director of the National Human Genome Research Institute (NHGRI) of the National Institutes of Health, Director of the Institute's Division of Intramural Research, as well as Chief of the Genome Technology Branch and Director of the NIH Intramural Sequencing Center.

April 12, 5:00 p.m. Dr. Edward A. Lee, Professor of Electrical Engineering and Computer Science at U.C. Berkeley. His research interests center on design, modeling, and simulation of embedded, real-time computational systems. He is a director of CHESS, the Berkeley Center for Hybrid and Embedded Software Systems, and is the director of the Berkeley Ptolemy project.

Glass, Robertson, Bertsekas and Mishra: 2004 ISR Distinguished Lecturers

ISR hosted four exciting talks in 2004. February: **Leon Glass,** the Isadore Rosenfeld Chair in Cardiology and Professor of Physiology, McGill University, Montreal, on "Dynamics in Genetic Networks." April: **George Robertson,** ACM Fellow and Senior Researcher at Microsoft Research, on "From Hierarchies to Polyarchies: Visualizing Multiple Relationships." October: **Dimitri P. Bertsekas,** the McAfee Professor of Engineering, Laboratory for Information and Decision Systems at the Massachusetts Institute of Technology. on "A Unified View of Temporal Difference Methods for Neuro-Dynamic Programming." November: **Bhubaneswar "Bud" Mishra,** Professor of Computer Science, Mathematics and Cell Biology at Courant Institute and the NYU School of Medicine, on "Cell Talk."

MSAL open house showcases sensor and actuator nanotechnology



The MEMS Sensors and Actuators Lab's (MSAL) recent open house showcased its research in integrative MEMS and microsystems for novel microfabrication technologies in systems integration. The new technologies allow these devices to be integrated into improving the long-term reliability of "Systems-on-a-Chip."

Projects involve developing electrostatically driven micromotors and microgenerators supported on micoball bearings and investigating their tribological behaviors for power MEMS applications; integrating active and passive optical devices with MEMS actuators using III-V materials, and using spin-on materials such as polymers for developing smart microsystems with VLSI circuits for biological and medical use.

MSAL is directed by Assistant Professor **Reza Ghodssi** (ECE/ISR) and is affiliated with ISR, the Electrical and Computer Engineering Department, and the Small Smart Systems Center. It was established in January 2000. ES

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