



SYSTEM SOLUTIONS

THE INSTITUTE FOR SYSTEMS RESEARCH

The Institute for Systems Research

INSIDE

- 2 Director's Corner
- 4 Liu and Wu's pioneering digital forensics
- 5 Major awards to faculty
- 6 Cukier's computer security research
- 7 NanoCenter funding
- 7 CDC endorses clinic model
- 7 Echolocating bat strategy research
- 7 Honda R&D becomes ISR partner
- 8 Faculty news
- 10 Student news
- 11 Alumni news

Happy 20th anniversary, ISR!

ISR's 20th Anniversary Celebration Symposium on April 14 was a very special day.

The event was a combination scientific meeting and celebration of ISR's history and achievements, and was sponsored in part by Northrop Grumman Corp., a long-time ISR industrial collaborator.

Many friends and colleagues of ISR were present to wish us well.

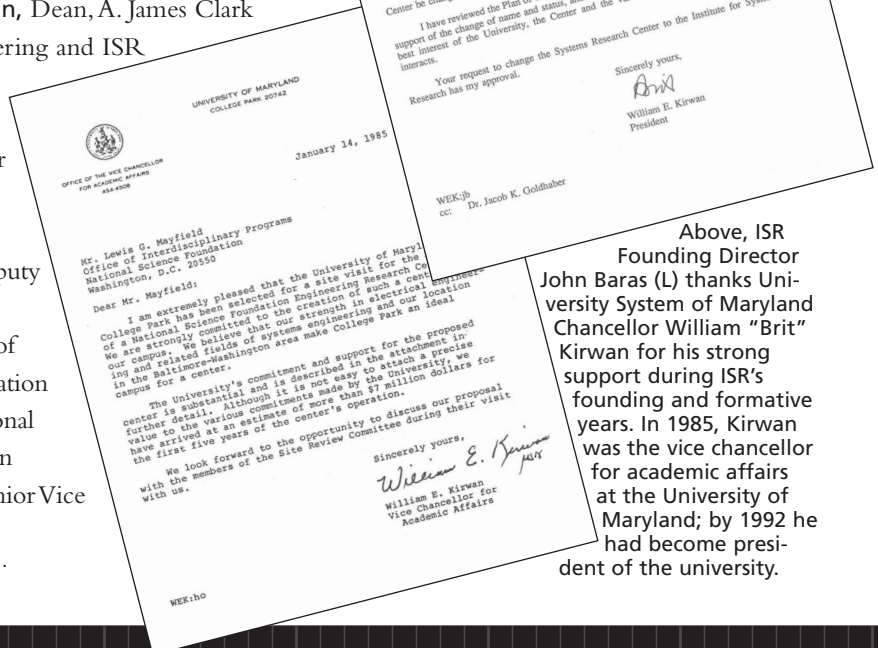
Among our luncheon speakers were:

- William "Brit" Kirwan, Chancellor, University System of Maryland
- C.D. (Dan) Mote, Jr., President, University of Maryland
- Nariman Farvardin, Dean, A. James Clark School of Engineering and ISR faculty member
- George Dieter, Emeritus Professor of Mechanical Engineering
- Lynn Preston; Deputy Division Leader, Centers; Division of Engineering Education and Centers; National Science Foundation
- John Kenyon, Senior Vice

continued on page 3...



Cliff Russell



Above, ISR Founding Director John Baras (L) thanks University System of Maryland Chancellor William "Brit" Kirwan for his strong support during ISR's founding and formative years. In 1985, Kirwan was the vice chancellor for academic affairs at the University of Maryland; by 1992 he had become president of the university.



As you can see from our cover story, our 20th anniversary celebration was a very special event. I thought you would enjoy reading a concise account of ISR's history and highlights over the years, written by two of our faculty who have been with us from the beginning: P.S. Krishnaprasad and Prakash Narayan.

Enjoy!


ISR Director Eyad Abed

Two decades of achievement

by P.S. Krishnaprasad and Prakash Narayan

The Institute for Systems Research was founded in 1985 as the Systems Research Center (SRC) at the University of Maryland and Harvard University, and was established by a National Science Foundation grant as one of the first six NSF Engineering Research Centers.

The driving motivation for the SRC was to advance the efficient design and control of complex large-scale, spatially distributed engineering systems. Such systems, operating at multiple time-scales and under multiple criteria, are needed to perform complex functions in high technology services and industry.

Progress could be achieved only through cross-disciplinary research and educational programs in academia pursued in collaboration with industry and government. Specifically, there was a need for integrating analytical and computational techniques of control and communication engineering with advances in computer hardware and software, using refined system-level design tools.

To this end, the research and educational programs of the SRC, during its first eight years, grew on a foundation of four

interrelated research areas, each focusing on a particular domain of applied engineering systems: intelligent servomechanisms; chemical process systems; manufacturing systems; and communication and signal processing systems. A fifth research area of systems integration methodologies and tools was a prime connecting link.

Facilitated by state-of-the-art constituent laboratories, SRC faculty, research scientists and students at Maryland and Harvard developed a cross-disciplinary approach to research and education, making many notable contributions. These included new algorithms and software for constrained optimization with guaranteed global convergence; fundamental results in the modeling and control of interconnected mechanical systems; novel techniques for the management and performance evaluation of communication networks; mapping and elucidation of the tonotopic organization of the auditory cortex; feedback control techniques for polymer reactors; and parallel algorithms for graph problems. Accompanying achievements included:

- The discovery of bifurcation and control of stall scenarios for axial compressor engines;
- Development of motion description languages in the Harvard Robotics Laboratory and the Intelligent Servosystems Laboratory;
- Design and fabrication of the modular dexterous hand;
- Cellular decomposition of flexible production lines using group technology;
- Development of neural network models for the input-output behavior and model predictive control of chemical processes;
- High quality joint source-channel coding of images and related modem

technologies for voice and data;

- Protocols for mobile ad-hoc wireless networks; and
- Efficient algorithms and software for manufacturing process planning.

In 1992, the SRC became the Institute for Systems Research (ISR), a permanent institute at the University of Maryland. Over the next decade, its programs, linking several departments at Maryland and Harvard, evolved to support its broader strategic plan for developing fundamental knowledge and technologies of integrated design. Foci of this effort include complex engineered systems with control, communication, and biological or biologically-inspired subsystems. The initial emphasis during this period was on three research areas linked by common systems concepts, methods and algorithms:


- **Intelligent Control Systems:** The design of robust control systems, particularly motion control systems, flight controllers for aerospace systems, and chemical processes and industrial control systems.
- **Intelligent Signal Processing and Communication Systems:** the modeling, design and control of wireless and high-speed communication networks, the integration of signal processing and signal understanding, and the integration of signal processing and communication for control.
- **Systems Integration Methodology:** the development of models for system complexity, architectures for control and communication systems, integration of symbolic and numeric computing, integration of continuous and discrete optimization with AI techniques, and computer-aided design of manufacturing resource planning systems.

Driven by emerging communication net-

work technologies, ISR researchers foresaw the promise held by seamlessly connecting terrestrial and satellite systems. The Center for Satellite and Hybrid Communication Networks (CSHCN) was established within ISR by NASA as one of its Centers for the Commercial Development of Space. Now known as the Maryland Hybrid Networks Center (HyNet), its primary focus is to develop hybrid networks that link satellite and wireless systems with telephone, cable and cellular systems and the Internet.

ISR also developed key strengths in the area of semiconductor manufacturing processes which paved the way for the current emphasis on MEMS and nanotechnologies. Close collaboration with industry and national consortia made for the effective transfer of ISR technologies. Furthermore, ISR initiated a broadening of its scope through reaching out to the biological sciences and operations research.

Through the latter half of the 1990s to the present, ISR researchers have also created other centers of research collaboration with funding from NSF, DoD and NIH, to address challenging problems at the interface between system science and a variety of technology-oriented disciplines. Examples include the MURI Center on Smart Structures and NEXTOR, a multi-partner Federal Aviation Administration center headquartered in ISR that is devoted to air traffic scheduling.

Drawing on its extensive experience in creating and nurturing collaborative teams, ISR looks forward to making contributions in emerging disciplines. The future is bright for approaches that are rooted in system science and engineering. 

ISR's 20th anniversary celebration

... continued from page 1

President, Hughes Network Systems

- **Aris Melissaratos**, Secretary of Business and Economic Development, State of Maryland
- Six distinguished researchers gave technical lectures on exciting future systems research challenges in their specialty areas.

- *Wireless Sensor Networks for Traffic Monitoring*

Pravin Varaiya, Nortel Networks Distinguished Professor, Department of Electrical Engineering and Computer Sciences, University of California, Berkeley

- *Including the Cost of the Implementation in the Formulation of Optimal Control Problems*

Roger Brockett, ISR affiliated faculty member, An Wang Professor of Computer Science and Electrical Engineering, Division of Engineering and Applied Sciences, Harvard University

- *A Signal Processing View of the Changing World*


Bede Liu, Professor, Department of Electrical Engineering, Princeton University

- *Towards a Unified View of Communication and Control*

Sanjoy Mitter, Professor, Department of Electrical Engineering and Computer Science, Massachusetts Institute of Technology

- *Biological Systems Large and Small* **Eberhard Voit**, Professor and Georgia Research Alliance Eminent Scholar in Systems Biology, Wallace H. Coulter Department of Biomedical Engineering, Georgia Institute of Technology

- *Lessons Unlearned in Wireless*

Rajiv Laroia, Senior Vice President of Engineering, QUALCOMM Flarion Technologies, ISR alumnus, founder and CTO of Flarion Technologies. 



Speakers reminisce about ISR's history and accomplishments. Top to bottom: John Kenyon, Hughes Network Systems; Aris Melissaratos, Secretary of Business and Economic Development for the State of Maryland; Lynn Preston, National Science Foundation.

All photos this page by Cliff Russell

Digital detectives

Liu and Wu's pioneering new forensics technology helps catch cyber thieves

Professor K.J. Ray Liu (ECE/ISR) and ISR-affiliated Assistant Professor Min Wu (ECE/UMIACS) are creating new digital fingerprinting technology that could help protect Hollywood's assets and identify national security leak sources, all without impinging on legitimate uses.

As industry and government rely increasingly on digitized content, the problem of protecting such assets is becoming more challenging. Recent headlines have documented a new generation of cyber criminals who work together to engage in multimedia piracy, unauthorized data dissemination and security leaks.

The ISR researchers are developing innovative new "cyber forensics" technologies that will not only protect digital resources but also trace those who attempt to steal or misuse them through sophisticated "collusion attacks," a common piracy method. Collusion attacks occur when multiple users conspire to electronically steal and distribute copyrighted or clas-

sified material, diluting or erasing the original digital ID, or fingerprint, from the stolen multimedia content to avoid implication.

Wu and Liu's digital fingerprinting technology involves anti-

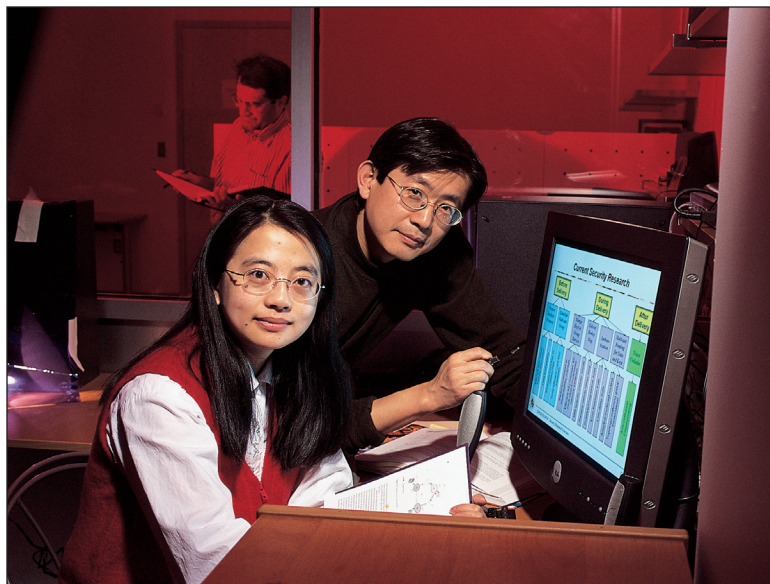
collusion codes (ACC). ACC protects multimedia content without compromising the quality of the multimedia product or inhibiting legitimate uses.

This powerful new technology could help the film and recording industries, who want to better protect the commercial copyrights of products distributed both domestically and abroad through the Internet and satellites. They are actively seeking technologies to individually and invisibly protect products without resorting to controversial methods that add programs to or alter individuals' computers.

Wu and Liu's digital fingerprinting method avoids this unpopular result. Their work protects multimedia content by embedding a unique ID that leaves a distinct fingerprint on each user's copy and can accurately identify which users have contributed to a piracy attack. They have developed the computer code and tools needed to embed, detect and decode it.

Fingerprints can be extracted to help identify culprits when unauthorized duplication is attempted. The technology can be applied to images, video, audio, and special documents like maps. It can even protect live multicasts, such as pay-per-view events. The system can accommodate up to millions of users, especially important for satellite and Internet multimedia distribution.

"We have introduced concepts that no one has thought of before," Wu says.




Min Wu and K.J. Ray Liu

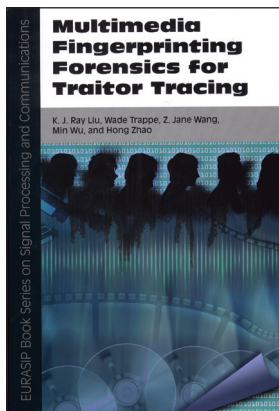
John Consoli

The pair believe the presence of sophisticated embedded ACC technology, with its ability to unmask colluders, will be such a powerful deterrent that it actually will prevent these kinds of piracy attempts. "The message our technology sends is, 'Don't bother to try anything, because we can catch you,'" according to Liu.

ACC technology also could have international security implications. To fight terrorism, information sharing is vital among international intelligence agencies. Yet without effective "traitor tracing" tools, entities have been understandably reluctant to share. In truly secure intelligence sharing that ACC technology could provide, multimedia information could be tracked, and those involved in attempts at unauthorized redistribution could be identified.

The team's award-winning research has captured the attention of colleagues in academia and industry worldwide. Liu is confident in ACC's potential. "This is must-use technology," he says. "The concepts we have pioneered will be used to protect the digital resources of the future."

To learn more, download an ISR Research Brief at www.isr.umd.edu/ISR/research/researchbriefs/Wu_Digital_Fingerprinting.pdf. 



This 2006 book by Liu, Wu, ISR alums Z. Jane Wang and Wade Trappe, and ISR postdoc Hong Zhao documents the ACC technology.

major AWARDS

DoD MURI: Cognitive architecture for reasoning about adversaries

Professor **Dana Nau** (CS/ISR) and ISR-affiliated UMIACS Director **V.S. Subrahmanian** (CS/UMIACS) are the principal investigators for “Cognitive Architecture for Reasoning about Adversaries,” a Department of Defense (DOD) Multidisciplinary University Research Initiative (MURI). The three-year project is funded at \$3.4 million, with an option for two additional years. The cross-disciplinary team also includes Professor **Michael Fu** (Business/ISR). The project will be funded by the Air Force Office of Scientific Research.

NSF MRI: Embedded systems for wireless sensor networks

Professor **Tony Ephremides** (ECE/ISR) is the principal investigator for a National Science Foundation (NSF) major research instrumentation grant, “Development of Energy-Efficient Embedded Systems for Wireless Sensor Networks.” The three-year, \$400,000 grant will develop experimental prototypes of intelligent, energy-efficient embedded systems for use in nodes of sensor networks. The goal is to develop advanced sensors that incorporate as many energy-saving features as possible, while at the same time remaining light, small, inexpensive and relatively flexible. Assistant Professor **Rajeev Barua** (ECE/ISR) is a co-PI, while Assistant Professors **Pamela Abshire** (ECE/ISR) and **Sennur Ulukus** (ECE/ISR) also are investigators.

NSF grant for speaker recognition

Associate Professor **Carol Espy-Wilson** (ECE/ISR) has received an NSF grant for “The Development of Low-Level Speaker-Specific Information for Speaker Recognition.” This three-year, \$431,000

grant investigates properties in the speech signal that can help recognize even people who are trying to conceal their identities. Possible applications include diagnostic tools for speech disorders, speech training aids, personalized human-computer interaction and speech recognition.

NIH: Auditory streaming

Shihab Shamma (ECE/ISR) is the principal investigator for a five-year, \$1.57 million grant from the National Institutes of Health’s (NIH) National Institute on Deafness and other Communication Disorders. The co-PIs for “Neural Correlates of Streaming of Complex Sounds” are ISR-affiliated Assistant Professor **Jonathan Simon** (ECE/Biology) and **Jonathan Fritz**, an assistant research scientist at ISR. This collaborative project combines psycho-acoustic and physiological investigations of a fundamental perceptual component of auditory scene analysis known as auditory streaming.

NSF DDDAS: Data-driven power system operations

ISR Director **Eyad Abed** (ECE/ISR) and ISR-affiliated UMIACS Director **V.S. Subrahmanian** (CS/UMIACS) are co-principal investigators of a new three-year, \$320,000 NSF award for “Data-Driven Power System Operations.” The principal investigator is Assistant Professor **Alan Sussman** (CS/UMIACS). **Priya Ranjan**, an ISR research associate, also is participating in the project. This is a collaborative project involving another NSF grant with the same title to the University of Illinois.

NSF/NIH: Neuromechanical locomotion

Professor **Avis Cohen** (Biology/ISR) is the principal investigator for “An Integrated Locomotion Model for Lamprey Swimming.” She will investigate whether steady locomotion in a predictable environment

requires only the neuromechanical system’s central pattern generator (CPG) without other input, and whether in an unpredictable environment, sensory feedback combined with strong intersegmental coupling is necessary. This grant in the NSF/NIH Collaborative Research in Computational Neuroscience (CRCNS) program is funded by the National Institute of Neurological Disorders and Stroke.

NSF DDDAS: Dynamic real-time order promising and fulfillment

Professor **Michael Ball** (Business/ISR) is the principal investigator and Professor **Michael Fu** (Business/ISR) is the co-PI for a three-year, \$633,000 NSF award for “Dynamic Real-Time Order Promising and Fulfillment for Global Make-to-Order Supply Chains.” It is part of the new NSF Dynamic Data Driven Applications Systems program.

ONR: High-altitude relay routers

ISR-affiliated Professor **Christopher Davis** (ECE) and his Maryland Optics Group, together with co-principal investigator and ISR-affiliated Senior Research Scientist **Stuart Milner** (CEE), have been awarded an Office of Naval Research contract for “High Altitude Relay Router Package: Optical/RF Data Links.” This three-year, \$2.7 million contract is shared with a sub-contractor, Techno-Sciences, Inc., of Lanham, Md. The team will construct novel, common aperture, hybrid-free, space optical (FSO)/RF communication transceivers mounted on high-performance gimbal stages. These will point to, acquire, and track directional beam wireless links that are fast and physically secure. ➤

Cukier's research quantifies computer security assumptions



Michel Cukier

The research of ISR-affiliated Assistant Professor **Michel Cukier** (ME) aims to provide quantitative, verifiable data that address common assumptions made by computer security professionals. Two of his recent projects have drawn the notice of international print, television, radio and Internet reporters from both technical and general interest news agencies.

Port scan assumption

A common computer security assumption is that “port scans” precede actual attempts to hack into computers (in a port scan, the hacker tries to find the availability and potential weaknesses of the computer). Research by Cukier and reliability engineering Ph.D. student Susmit Panjwani revealed that port scans precede attacks only about 5 percent of the time and that more than 50 percent of attacks are not preceded by a scan of any kind.

Because of their assumptions, many IT administrators first try to detect scans and then take preventive measures to secure their networks. The research shows they may be acting too late.

“We found that the confidence administrators have in their security solutions often seems to be misplaced,” says Cukier. “We now have scientifically derived data—we know what kinds of hackers attacked our research testbed network and what they did once they broke into it.” Read about the study in an ISR *Research Brief* at www.isr.umd.edu/ISR/research/researchbriefs/Cukier_QuantCompSecurity.pdf.

While collecting the data, Cukier realized the need for a tool

that checks for a wide range of host vulnerabilities for Windows computers. The result is *Ferret*, an open-source software tool that checks for these weaknesses on Windows platforms and automates what some Windows system administrators do manually to find and fix weaknesses. It includes more than 50 plug-ins. New plug-ins easily can be added as new vulnerabilities are identified. The code is available for free and available to study, not just use, to gain the trust of those who may want to install it.

Read about the software in an ISR *Research Brief* at www.isr.umd.edu/ISR/research/researchbriefs/Cukier_FERRET.pdf and download Ferret-Windows at ferret.sourceforge.net.

Attack threat on IRC channels

Internet relay chat (IRC) chatrooms are among the most popular chat services but offer widely varying levels of user security. Cukier and sophomore computer engineering student Robert Meyer found that in these chatrooms those using female usernames, on average, received 25 times more threatening and/or sexually explicit private messages than those with male or ambiguous usernames. The average was 163 malicious private messages a day. The researchers logged into various chatrooms under female, male and ambiguous usernames, counted the number of times they were contacted and tracked the message content. Their results were published in the proceedings of the Institute of Electronics and Electrical Engineers International (IEEE) Conference on Dependable Systems and Networks (DSN '06).

Simulated users or “bots” were not behind most of the malicious messages. “The extra attention the female usernames received and the nature of the messages indicate that male, human users specifically targeted female users,” Cukier said. “The best practice is to use gender-free or ambiguous usernames.”

Read the research paper at www.enre.umd.edu/content/rmeyer-assessing.pdf. [ES](#)

ISR faculty part of 10-year international technology contract

An IBM-based team that includes ISR-affiliated Professor **James Hendler** (CS) has been awarded a \$3.5 million International Technology Alliance contract with the U.S. Department of Defense and the United Kingdom's Ministry of Defence (MoD). ITA is a bilateral, cooperative technology concept created by MoD and the Army Research Laboratory (ARL) that brings together an international consortium of industry and academia to tackle complex information network issues crucial to coalition military operations. The business model is based heavily on ARL's

Collaborative Technology Alliances model, an effort led in part by Professor **John S. Baras** (ECE/ISR).

Research areas are network theory; security for highly mobile ad-hoc networks; sensor and information fusion; and distributed coalition planning and decision making in support of a tactical coalition force.

ECE Professor **Virgil Gligor** is the principal investigator; Hendler is co-PI. The team will work in security in systems of systems, and planning and decision making. [ES](#)

New funding for NanoCenter

The Maryland NanoCenter (formerly M-CINSE) has received two large funding grants. The NanoCenter is directed by ISR faculty member and former director **Gary W. Rubloff** (MSE/ISR), and its researchers include many ISR faculty members.

The Maryland General Assembly recently approved \$3.65 million in funding for the NanoCenter from the state's "Sunny Day Fund" and Governor Robert Ehrlich's nanotechnology initiative. The grant will fund major equipment for fabricating nanoscale patterns with electron beams and novel printing approaches; the controlled deposition of material at atomic and nanoscale dimensions; the characterization of nanostructure and properties; and associated support equipment for the FabLab in the Jeong H. Kim Building.

The National Institute of Standards and Technology (NIST) has made a \$1.5 million grant to the NanoCenter for a cooperative program to develop measurement technologies and other tools. The grant will support 13 researchers in the NanoCenter and NIST's new Center for Nanoscale Science and Technology. **ES**

CDC endorses Herrmann's clinic research

Associate Professor **Jeffrey Herrmann's** (ME/ISR) mass dispensing/vaccination clinic work with Montgomery County, Md., plays an important role in new guidance issued by the federal government's Centers for Disease Control and Prevention (CDC). The document requires that agencies receiving funding under a federal agreement use Dr. Herrmann's Clinic Planning Model Generator software as the model to help meet CDC's "preparedness control goal for mass prophylaxis." Read the guidance at www.bt.cdc.gov/planning/coopagreement/.

Herrmann also recently won the Achievement Award of the National Association of Counties (NACo) for his leadership in DAGWOOD, a mass dispensing/vaccination clinic exercise. Herrmann's work in improving mass vaccination clinic operations and his Clinic Planning Model Generator software are bringing him international attention. Learn more at www.isr.umd.edu/Labs/CIM/projects/clinic/. **ES**

Echolocating bats are hot news

The echolocating bat research of Professor **Cynthia Moss** (Psychology/ISR), Associate Professor **Timothy Horiuchi** (ECE/ISR), Professor **P.S. Krishnaprasad** (ECE/ISR) and Ph.D. student **Kaushik Ghose** (ISR Outstanding Graduate Student, 2004) frequently made the news in recent months.

One paper published by the quartet in *PLoS Biology* finds that bats use a strategy much like that employed by guided missiles to track and catch their prey. Moss and Ghose separately wrote on what bats do when their echolocating signal returns with clutter in addition to information about the potential food. The pair also published an article in the *Journal of Neuroscience* that indicates bats direct their sonar beams ahead of their flight, like a flashlight. By adjusting how sharply it follows its beam, the bat is able to adapt between "looking around" in search mode and "homing in" in attack mode.

News outlets interested in the research included The Discovery Channel, United Press International, physorg.com, *Science Daily*, *M&C Science and Nature*, local news radio station WTOP, and Germany's *Die Stern* newspaper. **ES**

industryNEWS

Honda R&D becomes ISR partner

ISR is pleased to announce that Honda R&D Co., Ltd., Japan, has become a partner within our Strategic Partners Program. Honda has collaborated with ISR through the Visiting Scientists Program since 1999, and has chosen to become a partner to continue this relationship.

The latest Honda Visiting Scientist is **Mr. Shigeru Narihiro**, an engineer working on automobile engines at the Tochigi Automobile R&D Center.

Mr. Narihiro is visiting with us for 14 months

and conducting control theory research with ISR-affiliated Associate Professor **Dave Akin** (AE) and Associate Professor **Robert Sanner** (AE).



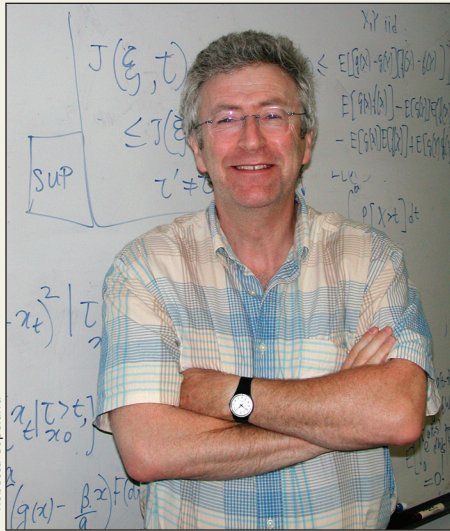
Honda Visiting Scientist
Mr. Shigeru Narihiro

Rebecca Copeland

Honda Initiation Grants

ISR faculty also are working on projects associated with two Honda Initiation Grants (HIG). Associate Professor **Carol Espy-Wilson** (ECE/ISR) is in year two of her HIG for "Probabilistic Framework for Acoustic-Phonetic Knowledge Based Continuous Speech Recognition." Professor **Shihab Shamma's** (ECE/ISR) HIG is for robotics work. He is researching auditory scene analysis, known as the "cocktail party problem"—how to focus on a single auditory stream in a multi-stream environment. He will use biologically inspired principles to detect and enhance speech signals in noisy and reverberant environments. **ES**

Fellows



Rebecca Copeland

Professor **Armand Makowski** (ECE/ISR) has been named a Fellow of the Institute of Electrical and Electronics Engineers (IEEE) “for contributions to traffic modeling and performance evaluation in communication and computer networks.”



John Consoli

Former ISR faculty member and Professor Emeritus **Thomas McAvoy** (ChemBio Eng) has been elected a Fellow of the International Federation of Automatic Control “for contributions to process control, particularly pioneering work on neural network applications, and for service

as Editor in Chief of the *Journal of Process Control*.”



John Consoli

Associate Professor **Carol Espy-Wilson** (ECE/ISR), has been named a Fellow of the Acoustical Society of America “for contributions to speech, communication and mentoring.”

New position

ISR-affiliated Professor **Mark Shayman** (ECE) has been appointed Associate Dean for Faculty Affairs in the A. James Clark School of Engineering.

Special recognition

ISR Founding Director and Professor **John S. Baras** (ECE/ISR) has been elected as a Foreign Member of the Royal Swedish Academy of Engineering Science (IVA).

The American Society of Mechanical Engineers awarded ISR-affiliated Professor **Roger W. Brockett** (Harvard) the prestigious Rufus Oldenburger Medal “for seminal contributions to differential geometric control, robot control and minimum attention control; and pioneering work on non-holonomic systems control that significantly influenced control theorists and engineers worldwide.” Former ISR Strategic Advisory Council member **Karl Astrom** (Lund Institute of Technology) won the award in 1985.

Awards

ISR-affiliated Professor **Joseph Jálá** (ECE/UMIACS) was one of four winners of the Internet2 Driving Exemplary Applications (IDEA) Awards, which recognize innovators who have created and deployed advanced network applications that hold the promise to maximize the impact of next-generation networks. Jálá’s project, “Transcontinental Persistent Archives Prototype,” focuses on safeguarding, preserving, and providing access to authentic electronic records documenting the rights of American citizens and the national experience. The prototype is a federation of different, independently administered computing platforms that interact as a single virtual repository.

Professor **Anthony Ephremides** (ECE/ISR) received the IEEE Information Theory Society’s 2006 Aaron Wyner Distinguished Service Award in recognition of his service and leadership in information theory.

Associate Professor **Guangming Zhang** (ME/ISR) has been selected as one of the A. James Clark School of Engineering’s first six Keystone Professors. The Keystone initiative honors faculty who have exemplary teaching skills and commitment to fundamental engineering courses. It is a renewable three-year appointment which includes a base salary increase, discretionary funds to support the recipient’s activities and additional support personnel. Keystone professors make a commitment to improving education in fundamental engineering courses. Previously, Zhang won the Clark School’s Poole and Kent Outstanding Teaching Award for Senior Faculty in 2004.

ISR-affiliated Assistant Professor **Miao Yu** (ME) has received a Ralph E. Powe Junior Faculty Enhancement Award. The award provides seed money for research by junior

faculty at schools that are a part of the Oak Ridge Associated Universities consortium. Yu received her Ph.D. in Mechanical Engineering from the Clark School in 2002. She was an ISR postdoctoral researcher in 2003–2004, working with Professor **John Baras** and ISR-affiliated faculty member **Mikhail Vorontsov** (ARL) in the Intelligent Optics Laboratory. Along with Professor **Balakumar Balachandran** (ME) and graduate student **Moustafa Al-Bassyiouni**, Yu received the University of Maryland's 2003 "Invention of the Year" award in physical sciences for developing a new fiber optic sensor system for acoustic, pressure and acceleration measurements of vibration.

Assistant Professor **Nuno Martins** (ECE/ISR) has won the American Automatic Control Council's 2006 O. Hugo Schuck Award for Theory. Martins won the award for his paper, "Fundamental Limitations of Performance in the Presence of Finite Capacity Feedback," which he presented at the American Control Conference in Portland, Ore.

Patents

Professor **John S. Baras** (ECE/ISR) and ISR alumni **Junfeng Gu** and **Yimin Jiang** were issued U.S. Patent 7,006,568 on Feb. 28, 2006 for "3D Wavelet-Based Video Codec with Human Perceptual Model," a video encoding/decoding system that applies "just noticeable difference" measurement in quantizer design to improve the subjective quality of compressed video.

ISR-affiliated Professor **Christopher Davis** (ECE); ISR-affiliated Senior Research Scientist **Stuart Milner** (CEE), and ECE Associate Research Scientist **Igor I. Smolyanivov** were issued U.S. Patent 6,990,350 on Jan. 24, 2006 for "Optical Wireless Networks with Adjustable Topologies," a method for dynamically

configuring the topology of a wireless network that uses both laser and RF wireless connections to allow transmission directions to be changed based on the needs of the network.

Books

Associate Professor **Jeffrey Herrmann** (ME/ISR) is the editor of *Handbook of Production Scheduling*, the latest in Springer's International Series in Operations Research and Management Science. The volume concentrates on real-world production scheduling in factories and industrial settings. It presents scheduling principles, advanced tools, examples of innovative scheduling systems, and includes a variety of real-world scheduling issues and analyses. Industry case studies that use innovative techniques as well as academic research results are included to improve real-world production scheduling.

Bruce L. Golden, Edward Wasil and ISR-affiliated Associate Professor **S. (Raghu) Raghavan** (Business) are the editors of *The Next Wave in Computing, Optimization, and Decision Technologies*. Computer science and operations research continue to have a synergistic relationship, and this book represents the results of the cross-fertilization between them.

Raghavan also co-edited *Telecommunications Planning: Innovations in Pricing, Network Design and Management* with Professor **G. Anandalingam** (Business/ISR). The book focuses on the latest methodological developments in pricing of telecommunications services, network design and resource allocation. Topics include global deregulation of the telecommunications industry, effective pricing and revenue management, competitive pressures, what successful telecommunications companies of the future will need to do to minimize their costs and still meet customer expectations, and

solutions to resource allocation problems.

Harmonic Analysis, Signal Processing, and Complexity, a new book based on a 2004 symposium honoring Professor **Carlos Berenstein** (Math/ISR), has just been published by Birkhauser. Berenstein and Professor **P.S. Krishnaprasad** (ECE/ISR) are contributors, along with ISR alums **David Walnut** (who also helped edit the volume) and **Radha Poovendran**.

Best papers

The data mining work of ISR-affiliated Associate Professor **S. (Raghu) Raghavan** (Business) and his colleagues Bruce Golden, Ed Wasil, Shreevardhan Lele and Zhiwei Fu won the Institute for Operations Research and Management Science's (INFORMS) Computing Society Prize for their work in data mining. The prize was for a collection of three papers that describe state-of-the-art and novel genetic algorithms to design high-quality classification trees. The papers appeared from 2003–2005 in the journals *Operations Research*, *INFORMS Journal on Computing*, and *Computers and Operations Research*.

ISR-affiliated Assistant Professor **Min Wu** (ECE/UMIACS), Professor **K.J. Ray Liu** (ECE/ISR), and ISR alums **Z. Jane Wang** and **Wade Trappe** received a Best Paper Award from the IEEE Signal Processing Society. "Anti-Collusion Fingerprinting for Multimedia" is one of the first works on the topic in the literature. It has introduced several pioneering concepts and has been followed by colleagues in both academia and industry worldwide. Wade Trappe received his Ph.D. in 2002 and is now an Assistant Professor at Rutgers University. Jane Wang was a Postdoctoral Research Associate with ECE and ISR during 2002–2004 and is now an Assistant Professor at the University of British Columbia,

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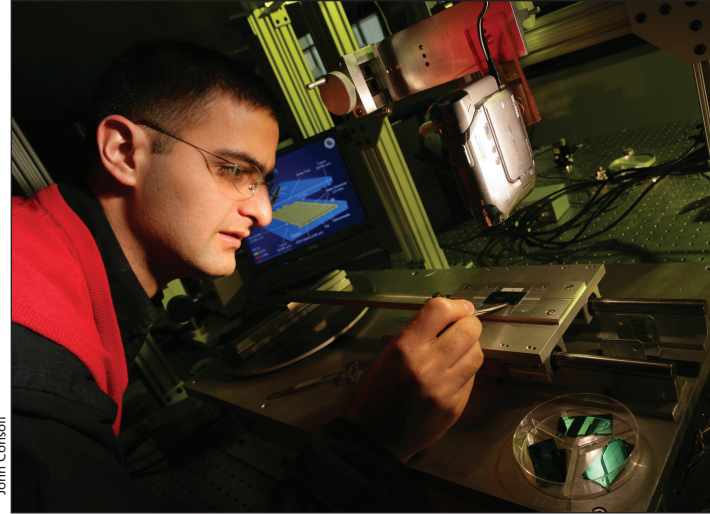
Vancouver. See our feature article about this research on page 4.

Technology entrepreneurship

NetImmune, Inc., a start-up company developed by ISR-affiliated Professor **Mark Shayman** (ECE), **Mehdi Kalantari**, a 2005 ECE Ph.D. and current ECE assistant research scientist; and **Mehdi Alasti**, a 2001 ECE Ph.D.; won the Award for Entrepreneurship at the University of Maryland's 2006 Invention of the Year awards. The entrepreneurship award is sponsored by the Maryland Technology Development Corp. (TEDCO). NetImmune, located in Germantown, Md., develops products to protect Internet networks by mimicking human immune system responses. Shayman is developing a high-speed prototype platform in a real network environment to detect and prevent distributed denial of service and intrusion attacks. By detecting network attacks at early stages, NetImmune's technology can prevent substantial damage from occurring.

Editorship

ISR Senior Research Scientist **Carl Landwehr** has been named editor-in-chief of *IEEE Security and Privacy*, a publication of the IEEE Computer Society. Dr. Landwehr is an expert in trusted computing, including high assurance software development and understanding software vulnerabilities. Landwehr also is the coordinator of the National Science Foundation's Cyber Trust area within its Computer and Information Science and Engineering Directorate. [ES](#)



John Consoli

ISR-affiliated Ph.D. student **Nima Ghalichechian** (above) is a recipient of the American Vacuum Society's (AVS) 2006 Graduate Research Award, a prestigious nationwide competition. The award recognizes the quality of the body of research of individual graduate students. Nima, an electrical and computer engineering student, is advised by Associate Professor **Reza Ghodssi** (ECE/ISR). Nima is the second student from Ghodssi's MEMS Sensors and Actuators Lab to be honored with the award in four years; Ph.D. student **Alireza Modafe**, who expects to graduate this summer, won in 2002. He also is advised by Dr. Ghodssi—who coincidentally won the same award in 1995 when he was a graduate student at the University of Wisconsin. Nima also recently presented "Dynamic Characterization of a Linear Variable-Capacitance Micromotor" at the 2006 Solid-State Sensor, Actuator, and Microsystems Workshop.

ISR-affiliated Ph.D. candidate **Jiaqiao Hu** (ECE) will join the Applied Mathematics and Statistics Department in the College of Engineering and Applied Sciences at SUNY Stony Brook as assistant professor this August. Jiaqiao, who will graduate later this summer, is co-advised by Professor **Steve Marcus** (ECE/ISR) and Professor **Michael Fu** (Business/ISR).

Jiaqiao received a B.S. in Automation from Shanghai Jiao Tong University and an M.S. in Applied Mathematics from the University of Maryland, Baltimore County. His research interests include Markov decision processes, applied probability, and simulation optimization.

Daniel Fitzgerald, a graduate student advised by Associate Professor **Jeffrey Herrmann** (ME/ISR) and Associate Professor **Linda Schmidt** (ME/ISR), is one of the winners of the ASME/NSF Design Essay Competition. Earlier, Fitzgerald also won a 2005-2006 ARCS Scholarship.

ISR grad student **Luke Winternitz** co-wrote an article on his NASA work for the April 2006 issue of *GPSWorld* magazine. The article explains the development of a GPS receiver for high-altitude (above the GPS constellation) satellite navigation. Winternitz notes, "There are many challenging issues with operating a receiver above the GPS constellation and ours is one of the first to specifically target this application."

Winternitz is currently working on his Ph.D. in electrical and computer engineering. He is advised by Professor **P.S. Krishnaprasad** (ECE/ISR). He is employed by the NASA Goddard Space Flight Center, which is enabling him to pursue full-time Ph.D. research in stochastic control and machine learning as part of its study-fellowship program. [ES](#)

alumniNEWS

ISR alumnae **Haitao “Heather” Zheng** (ECE/ISR) is featured in MIT *Technology Review*’s “Ten Emerging Technologies,” a short list of technological innovations “ready to have a big impact on business, medicine, [and] culture.” It is the second time in six months that MIT cited Zheng for her innovative technology research. Last September, she was named to the “TR 35” list of top technology innovators under age 35. Zheng, who was advised by Professor **K.J. Ray Liu** (ECE/ISR), was cited for her work with cognitive radio technology as a method for enabling wireless devices to more efficiently share available airwaves. Zheng’s research addresses the problem of competing wireless devices and dearth of available radio spectrum, given the competing frequency ranges dedicated to AM radio, VHF television, cell phones, citizen’s-band radio, pagers and other electronic media. It focuses on alternative methods to utilize unused frequencies within the radio spectrum. Cognitive radio devices are able to determine which frequencies are quiet and to pick one or more over which to transmit and receive data.

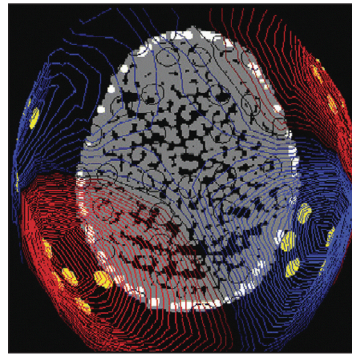


Former ISR postdoc **Ye (Geoffrey) Li** (left) has been named an IEEE Fellow. Li worked with Professor **K.J. Ray Liu** (ECE/ISR) in the mid-1990s. Today he is an associate professor in the Electrical and Computer Engineering Department at the Georgia Institute of Technology, where he directs the Information Transmission and Processing Laboratory.

ISR alum **Eytan Modiano**, already an associate professor at the Massachusetts Institute of Technology, has earned tenure there. Eytan earned his Ph.D. in Electrical Engineering in 1992; his advisor was Professor **Anthony Ephremides** (ECE/ISR) for both his M.S. and Ph.D. Ephremides writes, “He was among the first crop of great students that came out of the establishment of ISR in the mid ’80s with the likes of Scott Corson, Rajiv Laroia and Leandros Tassiulas.” At MIT, Eytan is a specialist in optical and ad-hoc wireless networks and will be the technical program chair at IEEE INFOCOM. Ephremides continues, “He is one of the best known and respected researchers in the field worldwide. We are proud to have such distinguished graduates.”

ISR alum and current Michigan State University ECE Assistant Professor **Xiaobo Tan** has won a National Science Foundation (NSF) Faculty Early Career Development (CAREER) Award for his research, “Dexterous Biomimetic Micromanipulation Using Artificial Muscles: Modeling, Sensing and Control.” Tan currently directs the Smart Microsystems Laboratory and is part of an interdisciplinary research team on high assurance systems. He earned

his Ph.D. in Electrical and Computer Engineering in 2002 and was a research associate with ISR. His was co-advised by Professor **John S. Baras** (ECE/ISR) and Professor **P.S. Krishnaprasad** (ECE/ISR). He also worked with Associate Professor **Reza Ghodssi** (ECE/ISR). 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.



An axial view of the cortically generated magnetic field of a human listener, measured using whole head magnetoencephalography (MEG) at a single moment in time.

A paper by Ph.D. alumnae **Maria Chait** (Neuroscience and Cognitive Science) and her advisors Associate Professor **David Poeppel** (Linguistics) and ISR-affiliated Assistant Professor **Jonathan Z. Simon** (ECE/Biology) is featured on the cover of the journal *Cerebral Cortex*. “Neural Response Correlates of Detection of Monaurally and Binaurally Created Pitches in Humans” details the results of a

MEG-psychophysical study that investigated the timing of formation of the percept of pitch and the generality of hypothesized ‘pitch-center’ in the brain.



ISR and HyNet alumna **Mingyan Liu** (left) has been promoted to associate professor with tenure in the University of Michigan’s Department of Electrical and Computer Engineering. Mingyan received her MSSE degree in 1997 and her Ph.D. in Electrical Engineering in 2000. She was advised by Professor **John S. Baras** (ECE/ISR) for both degrees. Mingyan’s research interests lie in communication networks performance analysis, network modeling and simulation, resource allocation, building energy-efficient/high-performance networking mechanisms for wireless sensor networks, mobile wireless ad-hoc networks, and broadband satellite networks. She won an NSF CAREER Award for “Capacity-Driven Design of Large-Scale Wireless Sensor Networks” in 2003. Dr. Baras writes, “Mingyan is a truly outstanding researcher and educator. She has become a well recognized leader in wireless networks research, and has obtained several pace-setting results

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in network modeling and resource allocation. Mingyan is the first graduate of the MSSE program to become a tenured professor at a leading research university. Her contributions to HyNet were outstanding, especially in the Federated Lab consortium ATIRP and in our collaboration with Hughes Network Systems.”

Jie “Rockey” Luo, a post-doctoral fellow who has worked with Professor **Anthony Ephremides** (ECE/ISR) for the last four years, will join the Colorado State University Electrical Engineering Department faculty this fall. Luo did outstanding research work with Ephremides, his students, and Assistant Professor **Sennur Ulukus** (ECE/ISR). “Rockey has published extensively, written research proposals, and participated fully in the activities of the ECE Department and the Institute for Systems Research,” said Ephremides. “He deserves recognition and a warm salutation for the continuation of his academic career.”

ISR Ph.D. alum **Robert Day** recent-

ly was one of two winners of the INFORMS George B. Dantzig Dissertation Award for the best dissertation in operations research. The award is presented for operations research and management science that is innovative and relevant to practice. Day’s advisor was ISR-affiliated Associate Professor **S. (Raghu) Raghavan** (Business). Day is currently an assistant professor at the University of Connecticut.

Balaji Sampath, a former student of Professor **K.J. Ray Liu** (ECE/ISR), was awarded the Massachusetts Institute of Technology Indus Technovator Award for his work with the Association for India’s Development, a non-profit, volunteer organization committed to promoting sustainable, equitable and just development in India, particularly at the country’s grassroots. 

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