FALL 2005 | Vol.20, No.2

SYSTEM SOLUTIONS
THE INSTITUTE FOR SYSTEMS RESEARCH

The Institute for Systems Research

INSIDE

ISR faculty win two 'Invention of the Year' awards

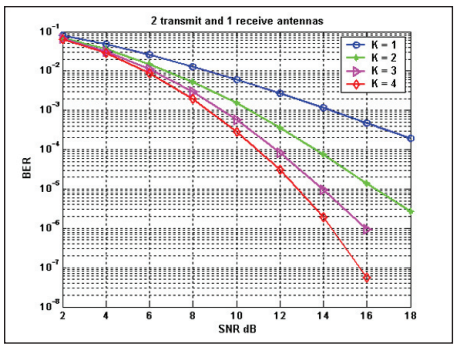
...and three other ISR-related inventions were finalists at the University of Maryland's 18th annual Invention of the Year awards. The awards are presented annually by the university's Office of Technology Commercialization to honor outstanding inventions and inventors from the previous year.

Information Science winners: Liu, Su and Safar

Professor **K.J. Ray Liu** (ECE/ISR), along with ISR postdoc **Dr. Weifeng Su** and ISR alum **Dr. Zoltan Safar**, won for "Coding Techniques for Maximum Achievable Diversity in Space, Time and Frequency for Broadband Wireless Communications."

They invented three space-frequency (SF) code design methods that can guarantee reliable data transmissions at high data rates in broadband wireless communications. Theirs is the first coding scheme to guarantee both full rate and full diversity in such communications. No other technology demonstrates the same functionality. This technology has potential applications in the design of the next generation of broadband wireless communication systems. A U.S. patent application is pending. Novel features include:

- The inaugural design of full diversity SF codes from space-time (ST) codes;
- The first systematic SF code design method that can guarantee both full rate and full diversity in multiple-input-multiple-output orthogonal frequency division multiplexing (MIMO-OFDM) wireless communication systems; and
- A space-time frequency (STF) transmission scheme, capable of coding across multiple OFDM blocks, to further exploit all the available diversity in MIMO-OFDM systems.



Performances of the full-rate STF code over *K=1,2,3,4* OFDM blocks, with TU channel model in the Liu-Su-Safar invention.

The proposed SF/STF code designs are applicable to the most general channel model used in practice.

Physical Science winners: Shapiro, Abshire and Smela

In the physical science category, Assistant Professor **Benjamin Shapiro** (AE/ISR), Assistant Professor **Pamela Abshire** (ECE/ISR), and

continued on page 2...

director's CORNER

Advantage: ISR

The Institute for Systems Research will be celebrating its 20th anniversary in the spring. Over the years, one question that we frequently have heard is, "What are the advantages in partnering with ISR to develop technology and solve problems?"

One answer to this question is that ISR provides a unique environment, not only because of its interdisciplinary nature, but also because we are structured to help establish partnerships with industry.

ISR's unique environment of interdisciplinary research is composed of researchers from five colleges and 11 units across the University of Maryland campus. This allows ISR to bring together a diverse set of researchers that can address the necessary research issues as well as the needs of companies with which we collaborate.

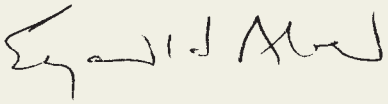
In addition to this interdisciplinary environment, ISR has a structural aspect that helps these partnerships become established. We have built into our organization a staff position that serves as a "one-stop shopping" function, dedicated to catalyzing, facilitating and integrating all the necessary elements that build a relationship.

As a gateway to the organization, our external relations director works across technical, legal and business domains, making connections, involving the appropriate staff and groups in industry and at the university, and generally smoothing the way for the relationship to flourish.

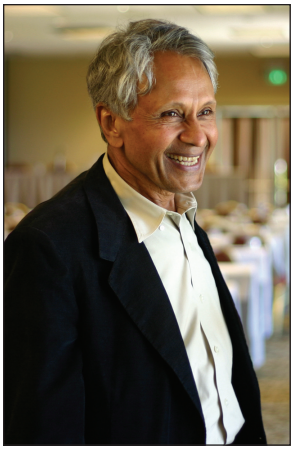
We also assist both industry and faculty in identifying joint research themes to take advantage of faculty expertise and insights as well as the needs of the company. Under our system, extensive discussions between faculty and industry representatives result in a collaboration that meets the needs of and adds value to the company and at the same time is intellectually stimulating to the faculty. Both these elements are critically important to the development of a successful partnership.

The presence of visiting scientists from our industrial partners at ISR enhances our ability to produce results that are readily implementable and rapidly transferred. Their communication of the company's perspective throughout the research process assures that the end result incorporates the company's needs.

Learn more about how this environment works and how fruitful a partnership with ISR can be by contacting ISR's External Relations Director **Jeff Coriale**, 301–405–6604, coriale@umd.edu.



ISR organizes symposium in honor of Pravin Varaiya



Pravin Varaiya

ISR organized the Symposium on Systems, Control and Networks in honor of **Dr. Pravin Varaiya,** June 5–7. More than 180 people attended the symposium and its related events, which were held at the Claremont Resort and Spa and the University of California, Berkeley, in Berkeley, Calif. It was sponsored by ISR, the Defense Advanced Research Projects Agency, the National Science Foundation and the University of California, Berkeley.

Dr. Varaiya, a professor at UC Berkeley, is a former member of ISR's Strategic Advisory Council.

Topics at the symposium included stochastic systems, hybrid systems, transportation systems, economics, networks and sensor networks.

The research presented at the symposium is recorded in the new book, *Advances in Control, Communication Networks, and Transportation Systems,* published by Birkhauser and edited by ISR Director **Eyad Abed** (ECE/ISR). View information about the book at *www.springeronline.com/sgw/cda/frontpage/0,11855,4-40109-22-51380752-0,00.html.*

... continued from page 1

Associate Professor **Elisabeth Smela** (ME) won for their invention, "Cell Sensor Based Pathogen Detection."

In a world plagued by terrorism, many research and development efforts are being dedicated to biochemical pathogen detection. Current commercially available pathogen detection systems have an unacceptably high rate of false positive results.

This new technology enables selective pathogen detection by exploiting the signaling machinery of living cells. The response of cells when exposed to a specific external pathogen is monitored.

This technology has applications in homeland security, pathogen detection and pharmaceutical screening. A U.S. patent application is pending.

Three other inventions from ISR faculty were finalists for the awards.

Information Science finalists: Austin, Everett, Mayank and Shmunis

Associate Professor **Mark Austin** (CEE/ISR), **David Everett** of NASA Goddard Space Flight Center, MSSE alum and former ISR Faculty Research Assistant **Vimal Mayank** and current ISR Faculty Research Assistant **Natalya Shmunis** were finalists for "A Tree-to-Graph Folding Procedure for Systems Engineering Requirements."

They formulated algorithms and implemented software tools for graph-based organization and visualization of requirements.

Requirements management capability improves success in team-based development of complex multidisciplinary systems. Elements of this capability are an ability to identify, manage and validate requirements during the early phase of the system design process, when errors are cheapest and easiest to correct.

Commercial requirements management tools such as SLATE, CORE and DOORS provide the best support for top-down development. Most of these tools represent individual requirements as textural descriptions with no underlying semantics. As a result, computational support for validation and versification requirements is still immature. Current tools cannot analyze requirements for completeness or consistency.

State-of-the-art practice organizes groups of requirements into tree hierarchies. However, graph structures are needed to describe "comply" and "define" relationships. When software tools employ a tree-based model to display relationships among requirements, gaps appear between the visual representation and the underlying graph-based data structures. Engineers then identify and close the gaps manually. The tree representation only works well when requirements "comply" and "define" branch from a single source.

The tools mitigate errors in the gap-closing process and augment, rather than compete with SLATE, CORE and DOORS. A U.S. patent application is pending.

Information Science finalists: Barua and Udayakumaran

Assistant Professor **Rajeev Barua** (ECE/ISR) and **Sumesh Udayakumaran** were finalists for "A Dynamic Memory Allocator for Embedded Systems with Scratch-Pad Memory."

Embedded computing systems are computing processors in devices other than dedicated computers. Embedded systems compilers produce executable code from source-level computer programs.

This invention automatically allocates program data in embedded computing systems with scratch-pad memories. Compared to currently used compiler technology, this new method reduces time, power consumption, programmer burden and cost. It can be used as a memory allocation tool in a compiler and as a hardware design tool. It can improve all types of embedded processor boards—a growing and lucrative market.

The invention can allocate all kinds of global and stack variables to scratch-pad memory using a dynamic method other than software caching.

When used to predict the smallest size of scratch-pad memory that meets runtime requirements, this technology reduces the size compared to current hardware design tools, resulting in reduced hardware cost.

This technology enables better use of scratch-pad memories, which have inherent cost, power consumption and access time advantages over hardware caches. It helps them live up to their full potential. A U.S. patent application is pending.

Physical Science finalists: Ghodssi and Morgan

Associate Professor **Reza Ghodssi** (ECE/ISR) and grad student **Brian Morgan** were finalists for "On-Chip Active Optical Fiber Alignment System using Gray-Scale Technology."

Aligning and packaging optical devices, such as a fiber to an LED or an optical switch is a major challenge in producing telecommunication and optical network components. This invention is a new approach for actively aligning optical fibers in packaging and testing optical devices.

Current commercial systems use expensive macro-size actuators that only package fibers serially or passive alignment platforms with expensive processing costs and lower product yield. The invention overcomes such deficiencies.

The system uses gray-scale technology methods to actively align each optical fiber to a component, enabling them to move both vertically and horizontally on a micro scale. This maximizes the amount of coupled light, preventing optical losses.

Unlike current methods, this new system is customizable for a variety of applications (including those requiring vertical actuation) and is easily adaptable to differences in fiber sizes, actuation ranges, system layouts and network substrate components. A U.S. patent application is pending. ES

major AWARDS

Min Wu is ONR Young Investigator

Congratulations to ISR-affiliated Assistant Professor **Min Wu** (ECE/UMIACS), who has been selected as an Office of Naval Research (ONR) Young Investigator. The three-year, $300,000 award will support her research in "Digital Fingerprinting for Multimedia Security and Forensics."

The program attracts young scientists and engineers who show exceptional promise for doing creative research and teaching. ONR believes its young investigators are the best and brightest young academic researchers in the country.

Min Wu is one of only 28 investigators ONR selected for its awards nationwide, and one of only two from its Mathematical Computer and Information Sciences Division. The competition for this award is substantial; ONR estimates that only 10 percent of the proposals submitted result in an award.

Ulukus wins CAREER award; receives ITR-Cybertrust wireless security grant

Assistant Professor **Sennur Ulukus** (ECE/ISR) has won a National Science Foundation (NSF) Faculty Early Career Development (CAREER) Award for "A Network Information Theoretic Approach to Wireless Ad-Hoc and Sensor Networks." She will investigate the capacity regions and capacity achieving transmit/receive coding/decoding schemes of basic network structures that are the building blocks of general ad-hoc, multi-hop wireless networks, with an emphasis on the interference channel.

Ulukus also has received a three-year, $240,000 NSF ITR-Cybertrust research grant for her work with Penn State's Aylin Yener on wireless security. "Multiuser Wireless Security" investigates the fundamental design principles of high capacity wireless systems that ensure secure information delivery for multiple users. She will develop a comprehensive framework for designing a multiuser physical layer to achieve high capacity and secure transmissions for all users, preventing intruders and eavesdroppers from disrupting or intercepting communications.

New MURI for dynamic ad-hoc wireless networking

Professor **Anthony Ephremides** (ECE/ISR), Assistant Professor **Sennur Ulukus** (ECE/ISR), and former Research Professor **Leandros Tassiulas** (ECE/ISR) are part of a recently announced Department of Defense Multidisciplinary University Research Initiative (MURI) grant under Army Research Office topic "Cross Disciplinary Approach to Modeling, Analysis and Control."

"DAWN: Dynamic Ad-Hoc Wireless Networking" addresses energy efficiency, cross-layer optimization, interaction between physical layers, MAC, routing, compression, and scalability of protocols. Special attention will be given to sensor networks where there is a need to map mission-specific performance measures to classical networking performance metrics.

The grant provides up to five years and $5 million in funding; the Maryland team's portion represents about 20 percent of the total. Dr. Ephremides is the principal investigator for the Maryland team.

The lead institution is the University of California, Santa Cruz. Other participants include the Massachusetts Institute of Technology; Stanford University; the University of Illinois Urbana-Champaign; the University of California, Berkeley; and the University of California, Los Angeles.

Shayman receives tech transfer award

ISR-affiliated Professor **Mark Shayman** has received a $50,000 tech transfer award from the Maryland Technology Development Corporation (TEDCO). The award will enable Shayman to commercialize software he developed that can detect and eliminate "denial of service" (DoS) attacks on Internet sites. These attacks are designed to shut down a network by flooding it with useless traffic.

Ghodssi wins grants for microball bearing technology and Fresnel lens development

Associate Professor **Reza Ghodssi** (ECE/ISR) has been awarded a three-year, $550,000 grant by the Army Research Laboratory's (ARL) Cooperative Agreement Power Component Branch, Sensors and Electron Devices Directorate. "Microball Bearing Technology in Silicon for Power MEMS," will improve the efficiency and reliability in the compact portable power generators soldiers use.

MEMS air/fuel control could enhance the efficiency and reliability of small liquid- and gas-fueled power sources in generator sets, UAVs and fuel cells. Dr. Ghodssi's MEMS Sensors and Actuators Lab will be developing a design methodology and microfabrication technology for a rotary electrostatic micromotor supported on microball bearings. This will be integrated with a mechanical micropump that can deliver heavy liquids to a fuel atomizer for heat engines and fuel cells.

Ghodssi also has received a three-year ROSS-2004 award for phase Fresnel lens development. The program, which holds great potential for space applications, had significant visibility at NASA this year, in part because of important contributions from two of Ghodssi's graduate students, **Brian Morgan** and **Mike Waits** (who works full time at ARL while a Ph.D. student in the ECE department).

The work was done in collaboration with Dr. John Krizmanic and his colleagues at NASA Goddard Space Flight Center.

NSF grant for feasible point optimization

Professor **André Tits** (ECE/ISR) is the principal investigator for a three-year, $200,000 NSF grant for "Feasible Point Optimization Methods for Design and Other Engineering Applications." The research will develop, analyze, implement, and test numerical algorithms to solve common engineering constrained optimization problems with a large number of inequality constraints. The algorithms and software should have a significant impact in a wide range of application areas.

NSF award for cell-based sensing

Assistant Professor **Pamela Abshire** (ECE/ISR) is the principal investigator for the NSF award, "Integrated Transduction, Actuation, and Control for Cell-Based Sensing." Assistant Professor **Benjamin Shapiro** (AE/ISR) and Associate Professor **Elisabeth Smela** (ME) are the co-PIs.

They are developing and demonstrating enabling technology for cell-based sensing, which has a potential for selectivity, sensitivity and speed that far exceeds current chemical and biological sensors. In addition to olfactory sensing and pathogen detection for national security, this technology has applications in health care, pharmaceutical development and environmental monitoring. The researchers' integrated transduction-actuation-control approach could impact labs-on-a-chip, microfluidics, and nanotechnology by developing basic technology and techniques for sophisticated manipulation of particles at the micro-scale.

Hendler wins NSF ITR award for semantic web

ISR-affiliated Professor **James Hendler** (CS/ISR) is the principal investigator for a three-year, $100,000 NSF ITR award, "Profile-Aware Web: Rules, Proofs and Trust on the Semantic Web." The project will investigate policies such as web rules language for the semantic web. This will be expanded to include security and privacy policies specification. Hendler will develop an inference engine to reason about privacy and trust policies and develop algorithms to enforce the policies.

NSF grant for broadband optical/RF wireless networks

ISR-affiliated Senior Research Scientist **Stuart Milner** (CEE) is the principal investigator for a three-year NSF grant, "Broadband Optical/RF Wireless Networks with Topology and Diversity Control." ISR-affiliated professors **Christopher Davis** (ECE) and **Mark Shayman** (ECE), along with Assistant Professor **Steve Gabriel** (CEE), are the co-PIs.

Broadband wireless networks (up to gigabit per second data rates) deployed in metropolitan areas could form a flexible and reconfigurable backbone of base stations (routers) and provide service to both fixed and mobile users. As extensions to the wireline Internet backbone, these high data rate systems could enable multimedia applications like video surveillance of buildings, bridges or traffic and remote environmental sensing.

The researchers are developing software for autonomous network reconfiguration in response to signals blocked by atmospheric effects such as fog, clouds, or heavy rain; and hardware techniques for signaling and intelligent switching between optical wireless and RF media to stabilize communication rates and minimize delays.

Reconfiguration switches between communication modalities (RF or FSO) for given link(s), redistributing communication traffic within the available modalities; and/or creation of new links to other nodes by pointing or steering agile transceivers, thereby changing the network's physical and logical topology.

Berenstein is PI for complex and harmonic analysis grant

Professor **Carlos Berenstein** (Math/ISR) is the principal investigator for a three-year, $120,000 NSF award, "Topics in Complex and Harmonic Analysis." This project will develop sophisticated mathematical techniques to play a central role in tomographic imaging and analysis of communication networks. The research could improve three-dimensional medical imaging and increase understanding of Internet traffic patterns and security threats.

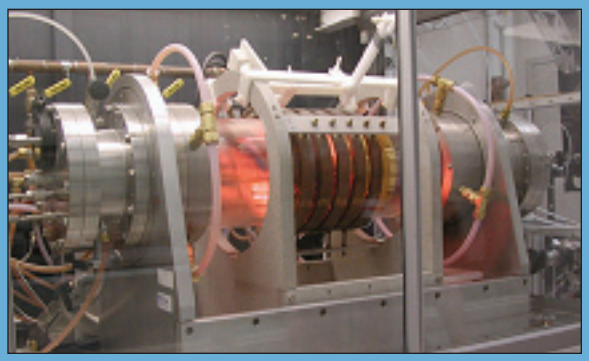
Sandborn awarded GOALI for sustainment-dominated systems

ISR-affiliated Associate Professor **Peter Sandborn** (ME) is the principal investigator for a one-year, $50,000 NSF SGER GOALI award, "Collaborative Research, Forecasting and Proactive Management of Obsolescence for Sustainment-Dominated Systems." It will explore industry and academic collaboration to determine how to combine multiple resource sources to impact proactive obsolescence of electronic parts through forecasting and management.

Nau is PI for AI planning NSF award

Professor **Dana S. Nau** (CS/ISR) is the principal investigator for a one-year, $140,000 NSF award for "Pushing the Boundaries of AI Planning." This project will develop planner-generalization techniques that can be used to modify AI planning algorithms to remove some of the restrictive assumptions found in classical approaches, such as: perfect knowledge about actions and objects and history of the planning environment, static planning environment, instantaneous actions, discrete time, determinism, and black-and-white solution criteria. ≡S

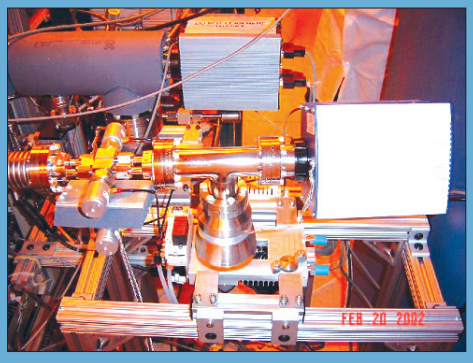
ISR research is significant component in Northrop Grumman's development of GaN device technology



Reactor for growth of GaN-based heterostructures for advanced devices

A significant new capability incorporating ISR research recently enabled Northrop Grumman Electronic Systems to move from an original Phase I to a considerably larger Phase II Defense Advanced Research Projects Agency (DARPA) program.

Gallium nitride (GaN) semiconductor films and related devices are the basis for the next generation of radar electronics, promising to increase power densities by a factor of 10, extend operational frequency and temperature range, and provide higher reliability than existing gallium arsenide (GaAs) devices. As a result, GaN-based devices will provide higher performance and robustness, giving them broad applicability for the demanding requirements of Northrop Grumman's applications. Because GaN technology is regarded as crucial for Northrop Grumman's future technology, the company has made a significant investment in new materials growth equipment, process technology and in-house researchers. The corporation also recognized the need for a broad research base to underwrite their GaN materials development, specifically to bring understanding, improved equipment and process design, and process control methods for manufacturability of the technology.



Real-time, in-situ chemical sensor for metrology and advanced process control

In Fall 2001, Northrop Grumman initiated a joint project to exploit ISR's skills in chemical process sensing, metrology, modeling and simulation, equipment design, and process control. The ISR team of Professor **Gary W. Rubloff** (Materials Science and Engineering/ISR/IREAP) and Associate Professor **Ray Adomaitis** (Chemical and Biomolecular Engineering/ISR) has a significant history of successful research and collaboration in applying expertise in these areas to semiconductor manufacturing equipment and processes for the silicon technology industry.

Within just a few years, the Northrop Grumman–ISR collaboration at the corporation's Baltimore Advanced Technology Laboratory (ATL) led Northrop Grumman to a leading-edge position in the industry in material quality and process control for the critical chemical vapor deposition processes used to fabricate the GaN devices.

The work of Dr. Rubloff, Dr. Adomaitis, and their students enabled Northrop Grumman to make the major improvements in film uniformity, layer thickness control, and process robustness that played an important part in winning the DARPA Phase II award.

Dr. Adomaitis's computer modeling of flow, temperature and chemistry led to equipment and process design advances that dramatically improved film uniformity across the wafers, a key element (and frequently a show-stopper) in achieving a manufacturable technology. Northrop Grumman's technology now achieves the best uniformity in the industry.

Dr. Rubloff's experimental work enabled Northrop Grumman to monitor chemical signatures during the materials growth process and to use them for advanced process control. Real-time mass spectrometric sensing, pioneered earlier in Rubloff's group, reveals chemical reaction products and uses them to determine film thickness in real time. The nanoscale AlGaN cap layer—only 20 nm thick—can now be controlled to about 1 percent precision (i.e., atomic scale), with direct benefit to achieving the high device speeds that directly depend on the thickness of this layer.

Northrop Grumman now routinely uses and relies on ISR's methods in its development process. Sensor-based metrology is exploited to automatically terminate the growth of the AlGaN cap layer, a nanostructure which is a direct determinant of device performance. The same sensor is employed to identify substandard material quality and equipment faults in real time. Gas delivery and process simulation tools are used by Northrop Grumman engineers to investigate possible improvements in system and process design.

These advances are currently being transferred to the new commercial MOCVD reactor recently purchased for GaN manufacturing, with guidance and help from ISR in defining specifications for the reactor and its subsequent opera-

tion and optimization. Ongoing work includes local chemical sensing for process insights, strategies for controlling run-to-run process drift, new sensor techniques, more sophisticated reactor and film deposition models, and applications to the new manufacturing reactor.

ISR's contributions are recognized by the company as an important component in its profound advances in the field, helping move Northrop Grumman to a position of competitive leadership in GaN-based materials and process technology for microelectronics systems, particularly in material quality, process uniformity, film thickness control, and manufacturability.

ISR faculty help develop new products via MIPS

ISR faculty are associated with five new Maryland Industrial Partnerships (MIPS) contract awards, which provide matching funding for university-based research projects that help companies develop new products.

Associate Professor **S.K. Gupta** (ME/ISR) is working with Automated Precision, Inc., of Rockville, Md., developing mathematical models, algorithms, and prototype software to facilitate the inspection of automobile and aerospace parts.

Professor **John S. Baras** and ISR Assistant Research Scientist **Nelson X. Liu** is working with CI Technologies of Frederick, Md., to develop an alternative emergency wireless communication service for commercial users and first responders. It will enable cell phone carriers to switch calls to work over satellite links during emergencies, using CI Technologies' gateway protocol software.

ISR-affiliated Professor **Mark Shayman** (ECE) is working with NetImmune, Inc. of Germantown, Md., to develop a high-speed prototype platform in a real network environment to detect and prevent Distributed Denial of Service and intrusion attacks. NetImmune's solution can identify a network attack within seconds to a few minutes; current systems can take more than a half hour. By detecting network attacks at early stages, NetImmune's technology can prevent substantial damage from occurring.

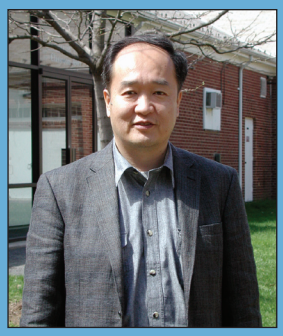
ISR-affiliated Professor **Neil Goldsman** (ECE) is working with TRX Systems, Inc., Lanham, Md., to develop a fire safe locator system that can centrally monitor the location, vital signs, and other situational information of first responders, both indoors and outdoors. ECE professors Gilmer Blankenship and Martin Peckerar are also involved.

ISR-affiliated professor **Christopher Davis** (ECE) is working with Techno-Sciences, Inc., of Lanham, Md., to develop a sensor package for weapons performance monitoring, target location and automatic counter-fire.

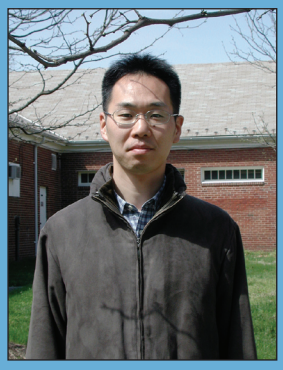
ISR collaborates with Toshiba

Takehisa Seino of Toshiba Corporation's Corporate Manufacturing Engineering Center and ISR's Assistant Director for External Affairs **Jeff Coriale** co-authored a paper on "Successful Industry-University Collaborations in Manufacturing Technology." In August, Coriale gave a presentation based on the paper at the Portland International Center for Management of Engineering and Technology's (PICMET) 2005 conference. The paper can be viewed in PDF format at *www.isr.umd.edu/ISR/TR_2005-99.pdf.*

ISR also welcomed two visiting scientists from Toshiba. **Mr. Tomoaki Kubo** is the chief research scientist for the Solution Project Group in Toshiba Corporation's Corporate Manufacturing Engineering Center. He is engaged in research and



development of inspection and quality control systems. During his stay, Mr. Kubo explored future research collaboration possibilities with Professors **Steve Marcus** (ECE/ISR and **P.S. Krishnaprasad** (ECE/ISR).



Mr. Ko Miyauchi is a researcher in the Mechatronics Development Center of Toshiba Corporation's Corporate Manufacturing Engineering Center, where his research centers on industrial machine development. During his six-month ISR visit, Mr. Myauchi is investigating reliability engineering with Professor Mohammad Modarres in the Mechanical Engineering Department.

Honda visiting scientist news

Mr. Masaaki Nagashima (left), ISR's 2004-2005 visiting scientist from Honda R&D, Japan, gave his final presentation on Aug. 25. Mr. Nagashima is an engineer who worked with ISR-affiliated Professor **William Levine** (ECE) on automotive exhaust emission and CO_2 control dur-

ing his year-long visit. His presentation, "Development of an Engine Idle Speed and Emission Controller," explained the results of this collaboration.

Former visiting scientist **Mr. Kazutomo Nishida** is one of the developers of Honda's recently released iGX440, a next-generation general purpose engine with electronic control technology. Mr. Nishida, who designs electrical components for general purpose commercial engines, was at ISR during 2001-2002. During his visit, he conducted research with ISR-affiliated Professor **Christopher Davis** (ECE) on projects involving sensor and control systems for general purpose engines.

Former visiting scientist **Mr. Naritomo Higuchi,** a Honda automotive engineer, was a speaker at the SAE Hybrid Vehicle Technologies Symposium, Feb. 9-10. Mr. Higuchi spoke about the Honda Accord Hybrid. He visited at ISR during 1999-2000, working with the late **Dr. Lung-Wen Tsai.**

Honda's new 2006 Honda Gold Wing has made the news recently for its first-ever motorcycle air bag. Former ISR Visiting Scientist **Mr. Yuichi Kato** played a large role in its production, designing almost all the plastic parts—front and side cowls, speaker box, front and rear fenders, trunk and saddlebag. Mr. Kato also designed the heated seat, grip heater, radiator, frame body, stays, exhaust pipe, muffler and air cleaner. Mr. Kato was one of ISR's first visiting scientists in 1999-2000, working with **Dr. William Levine**. Learn more about ISR's Visiting Scientist program at *www.isr.umd.edu/ISR/industry/VisitingScientistPgm.html*.

Herrmann's research helps improve mass vaccination clinic operations

'Patients' wait to receive medical consultations at a mass vaccination clinic set up as part of the TOPOFF 3 bioterrorism exercise in New Jersey this spring.

Were the U.S. to experience a bioterrorism attack, each affected county would be responsible for quickly vaccinating or providing medication to its residents. Most counties do not have experience with operating mass vaccination clinics. If the disaster happens, emergency responders could be overwhelmed by the magnitude of the task, leading to confusion and unrest.

County emergency preparedness planners need tools to help plan clinics with enough capacity to vaccinate residents quickly while avoiding congestion.

Associate Professor **Jeffrey Herrmann** (ME/ISR) and his research team have conducted simulation studies to evaluate emergency response clinic designs that would reduce waiting time and increase efficiency. They have developed a model generator that could help planners quickly estimate staffing needs for any type of clinic or treatment center.

Herrmann has done much of his work with Montgomery County (a Maryland county bordering the District of Columbia). At the county's mass vaccination clinic exercise, each patient was given a timestamp form upon arrival. The forms were stamped at six different stations, which allowed Dr. Herrmann's team to analyze the length of wait time for the proposed clinic design.

Using simulation software, the research team synthesized patient flow into a simulation model. The results were used with queueing equations to create a spreadsheet model accessible to most emergency preparedness planners. Custom queueing models can easily be created by users, taking into account the stations used in their clinic and appropriate population data. After creating the model, the user can adjust settings and staffing levels and immediately see the effects on the clinic. A report page provides a printable summary of clinic and station parameters and performance measures.

This spring Herrmann's team studied a mass vaccination clinic that was set up at the federal government's TOPOFF 3, a huge terrorism response drill designed to test the skills and equipment of federal, state and local agencies. His research also has attracted the attention of the National Association of County and City Health Officials (NACCHO).

The team has recently made its Clinic Planning Model Generator v.1.21 available for free download. It is a MS Excel spreadsheet with Visual Basic macros that runs in most Windows environments. A user guide, template and sample clinic model are also available. The generator was created by grad student Mark Treadwell and Dr. Herrmann with support from Montgomery County under a cooperative agreement from the Centers for Disease Control and Prevention to NACCHO. The generator can be downloaded at the mass vaccination project web site, *www.isr.umd.edu/Labs/CIM/projects/clinic/*. You can also view the ISR research brief on the subject at *www.isr.umd.edu/ISR/research/researchbriefs/Herrmann_MassVaccination.pdf*.

Summer internship with W.R. Grace led to position for ISR grad Pramod Agrawal

When ISR grad student **Pramod Agrawal** began a summer internship with W.R. Grace and Co. in 2003, he didn't imagine the relationship would last past his graduation and eventually turn into a full-time job. But that's exactly what happened.

Living in central India with a BS in Chemical Engineering from Pt. Ravi Shankar University, Raipur, Agrawal learned about ISR through his friend Arun Chaudhary, an ISR student who graduated in 2001. At ISR, Agrawal's research interests were in databases, information management system process control, and industry automation. His faculty advisor was ISR Director **Eyad Abed** (ECE/ISR).

During the summer internship in Grace's quality assurance division, Agrawal worked to develop a quality management information system and business reporting automation. During his last few weeks, he got an opportunity to work on data automation in Grace's Curtis Bay Works facility in Baltimore. Curtis Bay is a multi-plant facility that produces thousands of silica and alumina products which are later used in consumer products.

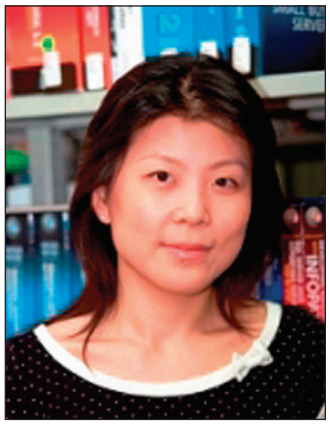
Agrawal saw an opportunity to research and develop a flexible database system that would capture heterogeneous data sources and manual entries. Together with Dr. Abed and Grace's management team, he worked on this system during his final semester. After graduating in December, Agrawal continued working with Grace as an ISR Faculty Research Assistant for a few months, after which Grace hired him full time as a software applications specialist for Curtis Bay's Information Services group. He served there through July 2005, with responsibility for application development and implementation.

Currently, Agrawal is CEO for Amicus Technology Pvt. Ltd. in India, a partner of Amicus USA, Inc., a Silver Spring, Md., based IT service company for the pharmaceutical, chemical manufacturing and bio-informatics industries. Through its partner company A-Team Solutions, LLC, Agrawal's team also works for the U.S. federal government on projects for Department of Health and Human Services. He also continues to support W.R. Grace's software needs.

Agrawal believes his education, research and interactions with ISR professors "played the most important role in preparing myself for the real world. The coursework improved my thought process and gave me a lateral thinking approach towards a problem. My chemical engineering education gave me the depth, and system engineering added multiple dimensions, giving me a comprehensive understanding of concepts."

ISR has a long and strong history of partnering with industry for the benefit of both the students and the companies. Our industrial partners can examine student work through our online Technical Reports system, locate students with relevant research interests via our online resume service, arrange to interview students for internships and permanent positions, and much more. *For more information, contact ISR's External Relations Director Jeff Coriale at coriale@umd.edu or 301–405–6604.*

Haitao Zheng named to 'TR 35' innovators list



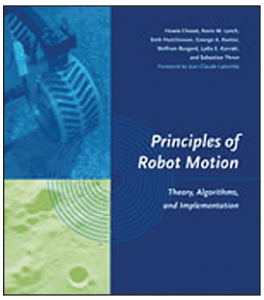
ISR alum **Haitao Zheng** has been named one of the top 35 innovators under the age of 35 by the Massachusetts Institute of Technology's *Technology Review* magazine. The magazine cited Zheng for her "youth and brilliance," noting her work on cognitive radios, which dynamically detect unused radio frequencies, helping alleviate competition in the radio spectrum.

Zheng will continue her research on open spectrum systems this fall in her new position as an assistant professor of computer science at the University of California, Santa Barbara.

Zheng earned her Ph.D. in Electrical and Computer Engineering in 1999, and was nominated for the TR 35 by Professor **K.J. Ray Liu** (ECE/ISR), her Ph.D. advisor. She won the 1998-1999 ISR Outstanding Graduate Student award and later worked for Microsoft Research in China.

The TR 35 list includes inventors, discoverers, and entrepreneurs engaged in emerging technology, recognizing individuals in both academia and industry whose "achievements will shape the world we live in for decades to come." ISR-affiliated Assistant Professor **Min Wu** (ECE/UMIACS) made the list in 2004. The list formerly cited the top 100 innovators, but was reduced to 35 this year.

Alumni news and notes



ISR alum **George Kantor** is co-author of the new book, *Principles of Robot Motion: Theory, Algorithms and Implementation,* published by MIT Press. Kantor earned his ECE Ph.D. in 1999. His advisor was Professor **P.S. Krishnaprasad** (ECE/ISR). Since graduating, Kantor has been a project scientist in the Field Robotics Center at the Robotics Institute, Carnegie Mellon University. He teaches courses in robotic manipulation and controls and conducts research in control, sensing and navigation for robotic systems. His research includes autonomous navigation for an underwater robot to explore the Zacaton cenote (a 300+ meter deep flooded sinkhole in northern Mexico), control of a human-sized mobile robot that balances on a single spherical wheel, and a distributed wireless sensor network for automation of intensive agricultural processes.

ISR alum **Sean Andersson** has accepted a position as Assistant Professor in the Boston University Department of Aerospace and Mechanical Engineering, beginning with the Spring 2006 semester. Since graduating with his ECE Ph.D. in 2004, Andersson has been a lecturer in applied mathematics at Harvard University, where he taught courses on linear systems and optimal control theory, operations research, exploring theory and applications of tracking in atomic force and confocal microscopy, and investigating gait-based control for hyper-redundant snake-like mobile robots. Andersson's Ph.D. advisor was Professor **P.S. Krishnaprasad** (ECE/ISR).

A paper co-authored by ISR alums **Jane Wang** and **Wade Trappe,** ISR-affiliated Assistant Professor **Min Wu** (ECE/UMIACS), and **Professor K.J. Ray Liu** (ECE/ISR) has been awarded the European Association for Signal, Speech and Image Processing's (EURASIP) *Journal on Applied Signal Processing* Best Paper Award for 2004. The paper is titled "Group-Oriented Fingerprinting for Multimedia Forensics."

ISR alum **Koushik Kar** has won a National Science Foundation Faculty Early Career Development (CAREER) Award for "Local Information Based Distributed Optimization of Resources in Large-Scale Adhoc and Sensor Networks." Kar is an assistant professor in the Department of Electrical, Computer and Systems Engineering at Rensselaer Polytechnic Institute in Troy, N.Y. Kar earned an ECE Ph.D. in 2002. His Ph.D. advisor was former ISR faculty member **Leandros Tassiulas**.

ISR alum **Aaron Falk** has been named the new chair of the Internet Research Task Force (IRTF). IRTF is a confederation of researchers in academia and industry who coordinate research, foster collaboration, and exchange information on Internet research. Falk is a computer scientist at the University of Southern California's Information Sciences Institute, where his latest research work is focused on the new XCP Internet protocol, aimed at easing Internet congestion. He earned a MS in Systems Engineering in 1994. While here, along with Douglas Dillon, Ilya Faenson and William Stanton (Hughes Network Systems); and Professor **John S. Baras** (ECE/ISR), Narin Suphasindhu, Vivek Arora and Tim Kirkwood of CSHCN, Falk was one of the inventors and coders of the prototype system for DirecPC (now DirecWay), a system that delivers broadband Internet access via satellite. ≡S

ISR students win awards


Brian Morgan

Two grad students—**Brian Morgan,** advised by Associate Professor **Reza Ghodssi** (ECE/ISR); and **Daniel Fitzgerald,** advised by Associate Professor **Jeffrey Herrmann** (ME/ISR) and Associate Professor **Linda Schmidt** (ME); have won 2005-2006 ARCS Scholarships, sponsored by the Metropolitan Washington Chapter of the ARCS (Achievement Rewards for College Scientists) Foundation, Inc. Morgan also won the scholarship in 2004-2005.


Daniel Fitzgerald

Morgan's research focuses on novel three-dimensional silicon MEMS microfabrication technology with an emphasis on electrostatic actuators. Fitzgerald's research interests are in design, risk assessment and manufacturing. He is also a winner of the 2005 ASME/NSF Design Essay Competition.

A paper written by grad students **Ashwin Swaminathan** and **Yinian Mao** and ISR-affiliated Assistant Professor **Min Wu** (ECE/UMIACS) won the 2005 Student Paper Contest sponsored by the Institute of Electrical and Electronics Engineers' (IEEE) International Conference on Acoustic, Speech, and Signal Processing (ICASSP). The work, "Security of Feature Extraction in Image Hashing," won the "Multimedia Signal Processing" category.

Graduate students **Alireza Modafe** and **Nima Ghalichechian** and Associate

continued on back cover...

Five new patents for ISR faculty, students and alumni

Three patents for Ephremides and Ayyagari

Professor **Tony Ephremides** (ECE/ISR) and ISR alum **Deepak Ayyagari** were recently issued three U.S. patents. Dr. Ayyagari earned his Ph.D. in Electrical Engineering in 1998; Dr. Ephremides was his advisor.

The pair received U.S. Patent 6,879,572 for "Power control for active link quality protection in CDMA networks." The invention is a system and method for dynamically limiting the power of all users of a CDMA digital data link to maximize throughput and reduce interference among users. In the data link, the maximum power available from each user of the link is determined along with the minimum power needed from each user to meet its link service requirement. The maximum-to-minimum power ratio is derived for each user and the lowest power ratio is selected and used to scale upward the minimum power levels of all users of the data link. The resulting power level establishes the interference margin or slack available for all users of the data link and the interference slack available for new users to be admitted to the data link.

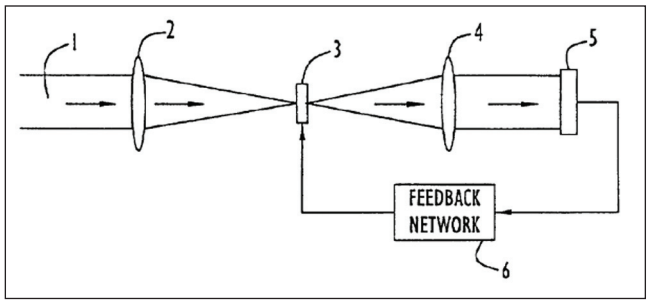
Ephremides and Ayyagari also were issued U.S. Patent 6,894,991 for "Integrated method for performing scheduling, routing and access control in a computer network." This is an integrated, highly adaptive method to perform scheduling, routing and access control in a network.

The pair also have been awarded U.S. Patent 6,947,407 for "Power control-based admission methods for maximum throughput in DS-CSMA networks with multi-media traffic." This is a method for maximizing data throughput over a multi-code DS-CDMA network by controlling the number of codes assigned to each user while controlling each user's power budget so that the bit energy to noise ratio is met, along with the quality of service and frame error rate requirements.

Wavefront phase sensors

Research Professor **Mikhail Vorontsov** (ISR), ISR Assistant Research Scientist **Eric Justh, Dr. Leonid I. Beresnev** (Army Research Laboratory), Professor **P.S. Krishnaprasad** (ECE/ISR); and **Dr. Jennifer Ricklin** (Army Research Laboratory) have been awarded U.S. Patent 6,911,637 for "Wavefront phase sensors using optically or electrically controlled phase spatial light modulators."

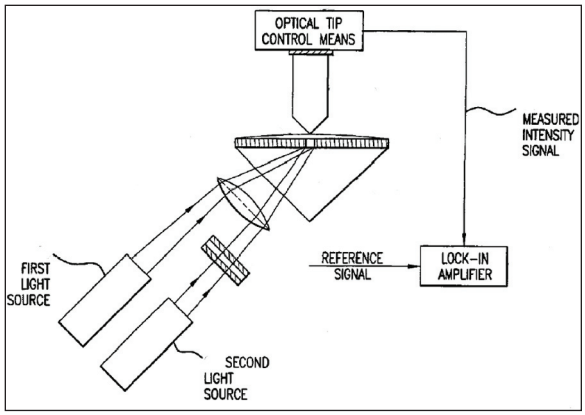
These systems and methods for optical wavefront sensing and control are based on a phase-contrast Fourier-domain filtering technique. Wavefront phase sensing is accomplished with an optically or electronically controlled phase spatial light modulator (SLM) as a Fourier-domain filter. The direct adaptive optic feedback system approach can produce high-resolution real-time correction of atmospheric turbulence-induced wavefront phase aberrations. Wavefront sensors could be used with conventional low-resolution adaptive-optic wavefront correction hardware based on deformable mirrors or multi-electrode wavefront phase modulators.



Wavefront phase sensors

Photon tunneling

ECE Associate Research Scientist **Igor I. Smolyanivov**; ISR-affiliated Professor **Christopher Davis** (ECE); and **Anatoly Zayats**, Queens University Belfast, were issued U.S. Patent 6,897,436 for "System and method for optical processing based on light-controlled photon tunneling."



Light-controlled photon tunneling

This patent is a system for optical processing based on light-controlled photon tunneling. It includes a prism with a metallic film layer on its upper surface that has a microscopic aperture covered by a layer of non-linear optical film. Selective actuation and modulation of two light beams allows for selective control over the rate and intensity of the photons which tunnel through the microscopic aperture. The intensity of transmission of the photons from the light beams are measured by an optical fiber tip, allowing for the creation of optical gates, switches, and other optical processing devices.

studentNEWS

...continued from page 10

Professor **Reza Ghodssi** (ECE/ISR) have received the 2004 MEMS and NEMS (MN) Technical Group Best Graduate Student Paper Award for their work, "BCB-Based Linear Micromotor Supported on Microball Bearings: Design Concepts, Characterization, and Fabrication Development."

Grad student **Jack Kustanowitz** was the lead author for the paper that won the Best Student Paper award at the ACM/IEEE Joint Conference on Digital Libraries 2005. He collaborated with Professor **Ben Shneiderman** (CS/ISR) on "Meaningful Presentations of Photo Libraries: Rationale and Applications of Bi-Level Radial Quantum Layouts."

Twelve students participated in ISR's summer **Research Experiences for Undergraduates** (REU) program, which brings together talented undergraduates from across the country to participate in focused, 10-12 week summer research experiences with individual ISR faculty members. It is funded by the National Science Foundation. This summer's students came from Brown, the University of Pennsylvania, Virginia Tech, Rochester Institute of Technology, Purdue, SUNY Genesco, Saint Louis University, UMBC, and the University of Maryland.

Graduate students **Marcel Pruessner** and **Kuldeep Amarnath** earned the Best Student Paper Award at the 17th Indium Phosphide and Related Materials (IPRM) Conference in Glasgow, Scotland, UK, last week.

The paper, titled "Indium Phosphide Based MEMS End-Coupled Optical Waveguide Switches," was co-authored by Pruessner, Amarnath, research associates **Madhumita Datta** and **Kanakaraju Subramaniam,** and Associate Professor **Reza Ghodssi** (ECE/ISR). Amarnath is advised by ECE Professor **Ping-Tong Ho** and Pruessner is advised by Dr. Ghodssi.

The award is a significant honor for the recipients; IPRM is one of the leading international conferences on Indium Phosphide (InP) materials and devices. ES

ISR **is a permanent state-supported institute of the University of Maryland within the A. James Clark School of Engineering. ISR is a National Science Foundation Engineering Research Center.**

2169 A.V. Williams Building, University of Maryland, College Park, MD 20742
Phone: 301.405.6615 **Fax:** 301.314.9920
Web site: www.isr.umd.edu
Editor: Rebecca Copeland

ISR Industrial Affiliates

Sustaining Partners
Northrop Grumman Corporation
Toshiba Corporation

Participants
Aerospace Engineering & Research Associates
Advanced Acoustic Concepts, Inc.
AnthroTronix, Inc.
America Online, Inc.
APEX/ECLIPSE Systems, Inc.
ATEC, Inc.
Automated Precision, Inc.
BAE SYSTEMS
Battelle
BBN Technologies, Inc.
Black & Decker
Boeing Communications
Calibrant Biosystems
E.I. DuPont de Nemours Company
Federal Express Corporation
General Dynamics
Honda Research and Development
Honeywell, Inc.
Hughes Network Systems
IBM—Rational Software Corporation
Instituto Trentino di Cultura (ITC)
Lockheed Martin Corporation
Merix Corporation
Metron Aviation, Inc.
Networks Associates, Inc.
Potomac Photonics
Southwest Research Institute
Telcordia Technologies
Vitech Corporation
W.R. Grace and Co.

A. JAMES CLARK
SCHOOL OF ENGINEERING

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

Nonprofit Org.
U.S. Postage
PAID
ICM