



# SYSTEMS SOLUTIONS

THE INSTITUTE FOR SYSTEMS RESEARCH

## The Institute for Systems Research

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John Consoli

## Highlighting ISR alumni!

Technical presentations by outstanding ISR alumni, a keynote address by Carnegie Mellon College of Engineering Dean **Pradeep Khosla**, a panel session featuring alumni collaborating with ISR and posters of more than 100 current research projects are just part of what's in store at ISR's 2008 Systems Symposium.

This free event is open to everyone in business, industry, government and academia interested in innovative cross-disciplinary systems research.

The event will be held on the University of Maryland, College Park campus at the Samuel Riggs IV Alumni Center. Continental breakfast and registration begin at 8:00 a.m. The program starts at 8:30 a.m.

The web site features easy online registration, directions to the Alumni Center, a detailed schedule of speakers and events, and titles of demonstrations and posters.

Alumni presenters include:

- **Ali Hirsa**, Head of Analytical Trading Strategy for Caspian Capital Management
- **Wade Trappe**, Associate Professor, Electrical and Computer Engineering, Rutgers University
- **Buno Pati**, CEO of Building B, Belmont, Calif.

Our alumni panel will talk about building collaborations with ISR.

Panelists are:

- **Robert Hoffman**, Principal Analyst, Metron Aviation
- **Scott Selberg**, System Archi-

tect, Signals and Networks Division, Agilent Technologies

- **Benjamin Levy**, Systems Analyst, Air Traffic Systems, Sensis Corp.
- **Vikram Manikonda**, Vice President and Director, Distributed Intelligent Systems Intelligent Automation, Inc.

Research posters and demonstrations will showcase current work in network security, mobile and sensor networks, hybrid communication networks, MEMS sensor/actuator design and fabrication, manufacturing and product realization systems, systems engineering methodologies, neuroscience and neuromorphic engineering, signal processing and multimedia systems, advanced control systems techniques, nanotechnology, supply chain management, transportation systems and air traffic management.

**Register online at**  
[www.isr.umd.edu/SS2008/](http://www.isr.umd.edu/SS2008/)

# Plasmon research yields superlens microscope; 2-D invisibility cloak

ISR-affiliated Professor **Christopher Davis**, ECE Research Scientist **Igor Smolyaninov**, and graduate student **Yu-Ju Hung** have used plasmon technology to create the world's first invisibility cloak for visible light. They have applied the same technology to build a revolutionary superlens microscope that can see details of previously undetectable nanoscale objects.

When we see an object, we see the visible light that strikes it and is reflected. The invisibility cloak refracts (or bends) the light that strikes it, so that the light moves around and past the cloak, leaving the cloak and its contents "invisible."

The device is a two-dimensional pattern of concentric rings in a thin, transparent acrylic plastic layer on a gold film. Because the plastic and gold have different refractive properties, the structure creates "negative refraction" effects.

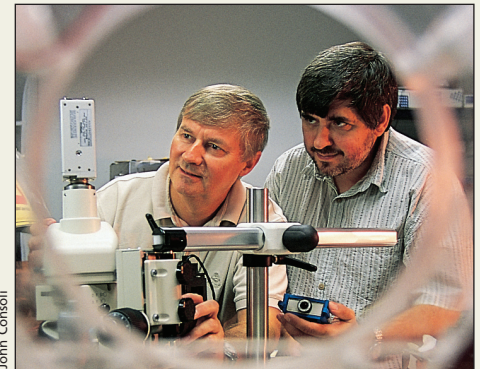
Plasmons—electron waves generated when light strikes a metallic surface under precise circumstances—bend around the

cloaked region. Because of this manipulation, the plasmon waves appear to have moved in a straight line. In reality they are guided around the cloak much as water in a stream flows around a rock, and released on the other side. Invisibility is not perfect because of energy loss in the gold film.

The researchers' cloak is just 10 micrometers in diameter; by comparison, a human hair is between 50 to 100 micrometers wide. Also, the cloak uses a limited range of the visible spectrum, in two dimensions. It is a significant challenge to extend the cloak to three dimensions because of the need to control light waves both magnetically and electronically to steer them around the hidden object. The technology initially may work only for small objects of a specific controlled shape.

The team also has used plasmonics to develop superlens microscopy technology, which can be integrated into a conventional optical microscope to view nanoscale details of objects that were previously undetectable.

The superlens microscope could one day image living cells, viruses, proteins, DNA molecules, and other samples, operating much like a point-and-shoot camera. This new technology could revolutionize the capability to view nanoscale objects at a crucial stage of their development. Davis and Smolyaninov believe they can improve the resolution of microscope images down to about 10 nanometers—one ten thousandth of the width of a human hair.

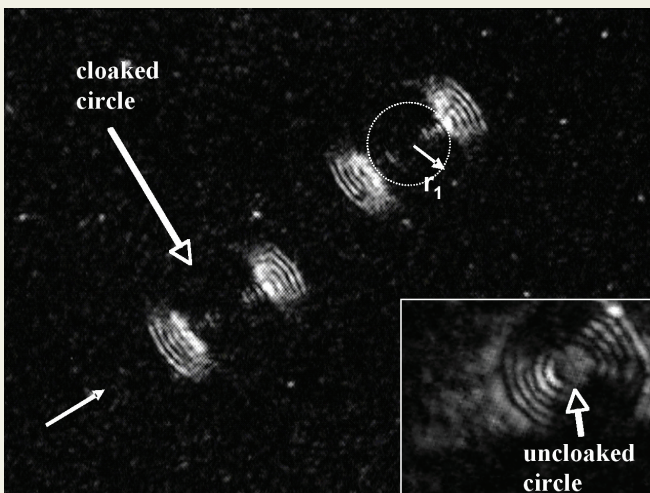


Professor Christopher Davis (left) with Research Scientist Igor Smolyaninov.

Surface plasmons have very short wavelengths, and can move data around using much smaller-scale guiding structures than in existing devices. These small, rapid waves are generated at optical frequencies, and can transport large amounts of data. The group also has made use of the unique properties of metamaterials, artificially structured composites that help control electromagnetic waves in unusual ways using plasmonic phenomena.

The research is funded by the National Science Foundation and BAE Systems. It has attracted a great deal of attention within the scientific community, industry and government agencies. Related plasmonics research offers applications for military and computer chip technologies, which could benefit from the higher frequencies and rapid data transfer rates that plasmons offer.

*Discover* magazine named the superlens microscope one of its "Top 100" science stories of 2007, and an article about the microscope appeared in the journal *Science*. The group and their colleagues from Purdue University also will soon publish a paper about the invisibility cloak research. A manuscript describing the invisibility cloak is available online at [arxiv.org/abs/0709.2862](http://arxiv.org/abs/0709.2862).



Optical image of surface plasmon-polariton propagation through these structures at 532 nanometers. The area inside the circle of radius  $r_1$  is cloaked, except for a very small fraction of plasmon rays, which propagate exactly through the centre of the cloak. The illumination direction is shown by the arrow. The inset demonstrates plasmon scattering by a typical concentric ring structure, which is not optimized for cloaking at 532 nanometers. The plasmons are strongly scattered by the edge of the structure and by the circular area in the middle.

# major **AWARDS**

## NIH: \$1.8 million for cancer treatment couch

Professors **Warren D'Souza** (University of Maryland Medical School), **K. J. Ray Liu** (ECE/ISR), and **Thomas McAvoy** (Emeritus, ChE/BioE/ISR) have received a \$1.8 million grant from the National Institutes of Health (NIH) for "Feedback Control of Respiration Induced Tumor Motion with a Treatment Couch."

A common problem in radiation treatment is that as the patient breathes, tumors move. Not only does this make the delivery of radiation to the right place more difficult, but also healthy tissue can be irradiated in the process. The research is improving the accuracy of delivering radiation therapy to cancerous tumors in the lungs and upper abdomen.

The heart of the project is a real-time tumor motion compensation system in a treatment couch. As the patient rests, the system uses both cinematic magnetic resonance imaging (cine MRI) to see the tumor as it moves, and an infrared camera to track markers on the patient's skin. It then correlates the position of the tumor with the position of the markers.

A feedback control system uses this data to adjust the couch, compensating for the patient's motion and in effect holding the tumor in a stationary position. The system also learns to predict tumor position by analyzing previous data, and adapts to irregular tumor positions and movements.

This method will be more efficient and effective than current solutions that involve the patient holding their breath—which can be difficult for an ill person—or gating, in which delivery is synchronized with the patient's breathing but at an increased treatment time and cost.

## NASA: Stochastic model of the national airspace system

NEXTOR, the National Center of Excellence for Aviation Operations Research,

has received a two-year, \$1.04 million grant from NASA to improve the U.S. air traffic control system.

"Advanced Stochastic Network Queuing Models of the Impact of 4D Trajectory Precision on Aviation System Performance" will build a large-scale stochastic queuing model of the national airspace system. It will enable the Federal Aviation Administration to analyze performance and reliability improvements to the air traffic control system.

Air traffic controllers often are unable to predict the arrival times of aircraft, leading to delays. The researchers will develop models and algorithms that address the problem of how to schedule and route planes so the delay on the entire system is minimized. The research uses four-dimensional (3D plus time) trajectories to better pinpoint an aircraft's exact position and arrival time.

Associate Professor **David Lovell** (CEE/ISR) is the principal investigator for the Maryland portion, along with several ISR alumni who hold senior positions at Intelligent Automation, Inc. (IAI) of Rockville, Md., another of the subcontractors.

## NSF: Systematic optimization in wireless multicasting

Professor **Tony Ephremides** (ECE/ISR) and former ECE postdoc **Jie (Rockey) Luo**, now an assistant professor at Colorado State University, have received a National Science Foundation (NSF) collaborative research grant for their work on Systematic Optimization in Wireless Multicasting. The three-year grant is worth approximately \$234,000.

Multicasting is the core component of many network applications such as multimedia distribution, information updating, group conferencing, etc. In multicasting, common information is transmitted from a source to multiple destinations. Creative

encoding of the network trace at intermediate terminals can significantly improve the throughput of a multicast. Because the wireless medium is open, the communication throughput of a wireless link depends on its transmission power and on the interference generated by nearby network terminals. This research will develop a systematic framework for maximizing a general multicast utility function by jointly optimizing transmission power, rate, and schedule, within the framework of network coding.

## NSF: CCF in multi-user wireless communications

Associate Professor **Sennur Ulukus** (ECE/ISR) is the principal investigator for "Correlation, Cooperation and Feedback (CCF) in Multi-User Wireless Communications," a three-year, \$350,000 NSF grant.

Correlated data in wireless communications may arise naturally in the observed data, as in sensor networks, or it may be created artificially by the communication protocol in order to improve the rates, as in user cooperation and feedback. Efficient handling of correlation is critical for the optimal design and operation of current and future wireless ad-hoc and sensor networks. Yet, what is known and settled in this field is extremely limited.

This research will develop a fundamental understanding and comprehensive theory for optimum distributed coding, transmission, creation and exploitation of correlation in multi-user wireless networks.

## NSF: Random graphs and modeling wireless networks

Professor **Armand Makowski** (ECE/ISR) is the principal investigator for a three-year, \$225,000 NSF grant, "Modeling Wireless Networks: Excursions in the Theory of Random Graphs."

The research will develop theoretical



foundations to assess system performance and help dimension attending resources in wireless networks. It will focus on three kinds of random graph models: random connection graphs, random intersection graphs and a combination known as Kryptographs. The models and research questions are driven by wireless networking connectivity and security applications.

The research will contribute to the study of random graphs (both geometric and non-geometric varieties) through probabilistic techniques. In addition, more realistic models for one-hop connectivity in wireless networks will be developed and the behavior of large scale wireless networks will be enhanced.

### NSF: Interactive virtual assembly

Associate Professor **S.K. Gupta** (ME/ISR) has been awarded a three-year, \$242,765 NSF collaborative research grant for “Automatic Generation of Context-Dependent Simplified Models to Support Interactive Virtual Assembly.”

Interactive virtual assembly is becoming an important tool for evaluating how easily proposed products could be assembled. It also can be used to train assembly operators. It could replace expensive and time consuming physical prototyping and training. However, models must be simplified for this promise to be realized.

Gupta will develop a mathematical theory and computational framework for automatically generating context-dependent simplified models to support interactive virtual assembly applications.

### NSF CSR-EHS: Run-time memory management

Associate Professor **Rajeev Barua** (ECE/ISR) is the principal investigator for a new NSF Computer Systems Research-Embedded and Hybrid Systems (CSR-EHS) grant, “Memory Management as a

Run-Time Service.” The three-year award is worth \$180,000.

Static Random Access Memory (SRAM) is essential to improving run-time, energy use and real-time bounds. Many embedded processors contain Scratch Pad Memory (SPM), unenhanced SRAM that is mapped to a portion of the address space. This offers better real-time guarantees than caches, an alternate SRAM memory type.

Although compiler methods that automatically allocate objects to SPM have existed for a decade, no commercial compiler currently uses them. Instead, programmers manually specify the SPM allocation using annotations.

The research will develop a SPM allocation strategy completely implemented inside a binary rewriter that will be automatically called by the operating system the first time the program is loaded to memory. Subsequent executions derive the benefits of SPM with no additional overhead. This approach makes SPM a run-time-provided resource for the first time, much like cache and virtual memory, making it ubiquitous and transparent to the software toolchain.

### NSF: Secure capacity of wireless networks

Associate Professor **Sennur Ulukus** (ECE/ISR) is the principal investigator for the NSF grant, “Secure Capacity of Wireless Networks.”

The three-year, \$250,000 award is a joint grant with Aylin Yener of Penn State University. This is Ulukus’ second joint NSF grant with Yener on wireless security. Their previous award, “Multiuser Wireless Security,” was granted in 2005.

Many people rely solely on wireless devices for communicating sensitive information. Security is currently dealt with at the higher layers of protocol hierarchies, yet there is a great need to incorporate it into the physical layer.

This project brings together information capacity and information security, exposing the tight coupling between the two. It will identify design principles for high-capacity and provably-secure wireless networks. It takes an information theoretic approach that provides guarantees on information security and information reliability for wireless networks. A comprehensive, secure, high-capacity wireless network design framework will be developed.

The researchers will help identify fundamental design tradeoffs of capacity versus security for a variety of wireless networks, and will provide design principles for future wireless communication systems achieving secure capacity limits.

### NSF: Optimal reference tracking

Assistant Professor **Nuno Martins** (ECE/ISR) is the principal investigator for a new NSF grant, “Optimal Reference Tracking, the Next Step in the Design of Controllers for Markovian Jump Linear Systems,” a two-year, \$85,000 award.

Modern engineering systems are a complex assemblage of mechanical components, electro-mechanical devices and sensors. Due to sudden fluctuations in the environment, component failure or assemblage interconnection disruptions, such systems may exhibit abrupt changes in their structure. Often, such variations are unpredictable, random or intermittent. Solar power plants, automobiles and manufacturing facilities are examples of systems whose dynamic behavior depends directly on environmental parameters that may fluctuate randomly.

This research will develop the first set of tools for performance analysis and design of controllers that achieve optimal reference tracking in this environment. The research will enable the design of safer, more efficient control systems in the presence of random and abrupt changes in the physical plant’s structure.

# Cell sensor-based pathogen detection

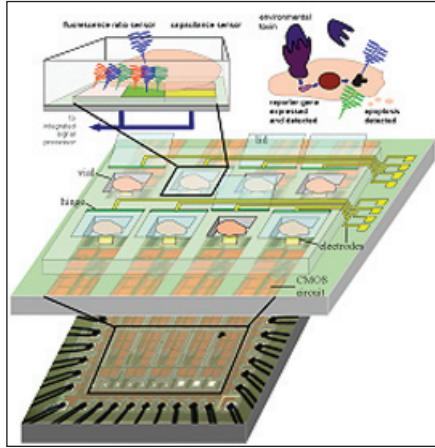
Associate Professor **Benjamin Shapiro** (AE/ISR); Assistant Professor **Pamela Abshire** (ECE/ISR); and Associate Professor **Elisabeth Smela** (ME) have been conducting cross-disciplinary research into “Cell Sensor-Based Pathogen Detection.”

The team also includes D. Wirtz, Johns Hopkins University; R. Das, Walter Reed Army Medical Center; and H. Mattoussi of the Naval Research Laboratory.

The problem with current generation biochemical weapons detectors is their unacceptable number of false positives. Existing detectors are easily fooled because they cannot distinguish among the subtle ways pathogens interact with biological systems. To solve this problem, the chip developed by ISR researchers uses biological systems that incorporate real cells to spot the pathogens.

The cells are exposed to potential pathogens in the air via a semi-permeable membrane. Much like a canary in a coal mine, these cells die when exposed to a particular pathogen, triggering an early warning. They also are engineered to produce a signal, such as fluorescence, when attacked. The system then quickly realizes pathogens are present. The cells are stored on a chip that keeps them alive and monitors the light they produce.

The research won the University of Maryland’s 2004 Invention of the Year Award in the physical science category and was featured on *New Scientist* magazine’s web site. in 2007. A patent application is on file with the U.S. Patent and Trademark Office.



# Cukier recommends wireless security precautions

A new study by ISR-affiliated Assistant Professor **Michel Cukier** (ME) indicates passwords alone may not provide enough protection for home wireless networks and are particularly inadequate for the wireless networks of larger organizations.

At many organizations and locations around the country, thousands of users access widespread wireless networks legitimately at any given time. But in turn, some of these users set up their own wireless networks, linked to the official network, to increase the signal in their office or home—what computer experts call an unmanaged wireless access point.

“If these secondary connections are not secure, they open up the entire network to trouble,” Cukier said. “Unsecured connections are an invitation to hackers seeking access to vulnerable computers.”

Cukier recommends that wireless network owners and administrators take the following precautions to better secure wireless networks from “parasites” trolling for access and unsecured connections set up by legitimate users:

- Limit the strength of your wireless network so it cannot be detected outside the bounds of your home or office.
- Turn off SSID broadcasting. A Service Set Identifier (SSID) is a code that identifies each packet as part of a network. When broadcasting is enabled, the network can be identified by all wireless clients within range. But when SSID

## studentNEWS

# Juanjuan Xiang wins best student poster award

Graduate student **Juanjuan Xiang** won the best student poster award in the neuroscience category at the University of Maryland’s BioScience Day event in November. Xiang, an advisee of ISR-affiliated Assistant Professor **Jonathan Simon** (ECE/BIO), won for her poster, “Neural and behavioral correlates of attention.”



Xiang is an electrical and computer engineering student. Her research bested all of the entries from students who are in the neuroscience and cognitive neuroscience program.

broadcasting is disabled, the wireless network is not visible to casual users unless the code is entered in advance into the client’s network setting.

- Use WPA/WEP encryption. If the wireless network traffic is encrypted, an attacker must decrypt the password before retrieving information transmitted over the network.
- Regular changing of the encryption key will also help protect the network. If the key is not changed often, a hacker might crack it.
- Accept only known MAC addresses. If a wireless access point only accepts connections from known MAC addresses (a serial number unique to each manufactured network adaptor), an attacker will need to learn the addresses of legitimate computers to access the network.

## Barg, Fu, Gupta named Fellows

All photos this page by John Consoli



Professor **Alexander Barg** (ECE/ISR) has been elected as a Fellow of the Institute of Electrical and Electronics Engineers (IEEE). He was recognized for his contributions to coding theory. Barg also was elected a member of the IEEE Information Theory Society's Board of Governors.

Barg's research interests include coding and information theory, combinatorics, and cryptography.



Professor **Michael Fu** (Robert H. Smith School of Business/ISR) has been elected a Fellow of the IEEE for contributions to stochastic gradient estimation and simulation optimization.

Fu's research interests are in simulation modeling and analysis; applied probability and queueing theory; stochastic derivative estimation; simulation optimization of discrete-event systems; Markov decision processes; supply chain management and financial engineering.



Associate Professor **S.K. Gupta** (ME/ISR) was elected a Fellow of the American Society of Mechanical Engineers (ASME) for significant contributions to computer aided design and manufacturing in incorporating application-specific intelligence into geometric reasoning algorithms. Research interests: computational foundations for computer aided design and manufacturing, emphasizing shape analysis and feature extraction, shape generation and synthesis, and model simplification.

## Miao Yu receives AFOSR Young Investigator award

ISR-affiliated Assistant Professor **Miao Yu** (ME) received the Air Force Office of Scientific Research (AFOSR) Young Investigator Program (YIP) Award for her research proposal to study the development of fly ear-inspired sensors on a micro-opto-electro-mechanical system (MOEMS) platform for use in micro air vehicles. As a part of this research, a novel bio-inspired localization scheme with adaptive capabilities will be studied by

using a single sensor with autonomous position control.

The total award amounts to \$308K for three years, and is intended to further support Yu's research on bio-inspired small-scale sensors. The objectives of the AFOSR YIP program are to foster creative basic research in science and engineering, enhance early career development of outstanding young investigators, and increase opportunities for young investigators to

recognize the Air Force mission and the related challenges in science and engineering.

Earlier in 2007, Yu received an NSF CAREER award, and in 2006, she received the Ralph Powe Junior Faculty Enhancement Award from the Oak Ridge Associated Universities (ORAU) consortium. Her present effort will complement as well as advance these research activities.



## Recognition



ISR-affiliated Associate Professor **Min Wu** (ECE/UMIACS) has been selected as one of *Computerworld's* 40 innovative information technol-

ogy people under the age of 40. The special feature appeared in the magazine's 40th anniversary issue last fall.

Wu was chosen for her innovative research in information security forensics. Wu and her colleagues have developed an invisible ID that can be embedded in digital content, such as films, music and pictures, to protect it from unauthorized use.

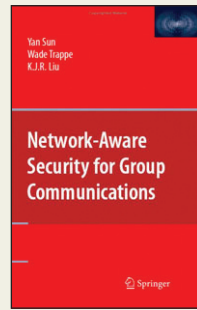
"Without a way to protect intellectual property, we will see a lot of hurdles to new technology put up," Wu told *Computerworld*. "My focus is working toward further innovation of new technologies."

The story is available on the *Computerworld* web site at [www.computerworld.com/action/article.do?command=viewArticleTOC&articleId=9024926](http://www.computerworld.com/action/article.do?command=viewArticleTOC&articleId=9024926).

Professor **G. "Anand" Anandalingam** (Robert H. Smith School of Business/ISR) has been appointed as senior associate dean of the Smith School. Anandalingam is the Ralph J. Tyser Professor of Management Sciences and holds a joint appointment with ISR. He will work closely with faculty and staff to support the college's overall program, research and curriculum development.

For the last three years, Anandalingam has chaired the Decision and Information Technologies Department. He is the founder of the Center for Electronic Markets and Enterprises and also helped found the Center on Health Information and Decision Systems.

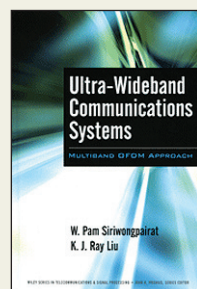
## Books



Professor **K. J. Ray Liu** (ECE/ISR) has co-authored a new book, *Network-Aware Security for Group Communications* with two of his former students. The book is a reference on how to

secure group communications in emerging networks and for future applications. Liu's co-authors are two of his former students, **Yan Sun** (Ph.D., 2004), assistant professor of electrical and computer engineering at University of Rhode Island, and **Wade Trappe** (Ph.D., 2002), associate professor of electrical and computer engineering at Rutgers University.

The book is focused on tailoring security solutions to the underlying network architecture (such as wireless cellular networks, or ad hoc and sensor networks), or to targeted applications using specifically tailored methods (such as multimedia multicasts). The authors focus the discussion on two fundamental security issues for group communications: providing efficient key management for confidentiality, and providing authentication for group services.



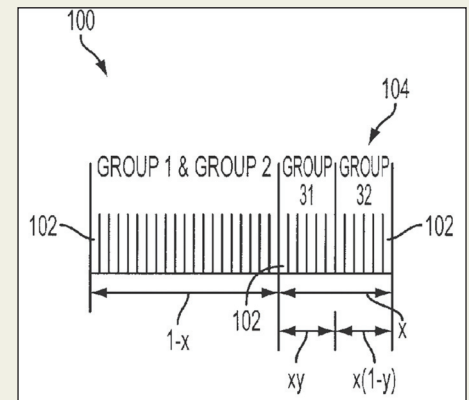
Liu also has co-written *Ultra-Wideband Communications Systems: Multiband OFDM Approach*, with a former student, **W. Pam Siri Wongpairat**.

The book is a comprehensive overview of fundamental issues related to designing, implementing, and deploying ultra-wideband (UWB) multiband orthogonal frequency-division multiplexing (OFDM) systems. It covers the key physical layer aspects of UWB technology, including spectrum and regulations, UWB channels, modulation tech-

niques, and transceiver architectures, with particular focus on the multiband OFDM approach. In addition, the book examines major advanced state-of-the-art technology that enhances the performance of standardized multiband OFDM technology.

Siri Wongpairat received M.S. and Ph.D. degrees in electrical engineering from the University of Maryland in 2001 and 2005. She also was a post-doctoral researcher with ECE and ISR. Siri Wongpairat is currently a wireless communications specialist with Meteor Communications Corp.

## Patents



Professor **Tony Ephremides** (ECE/ISR), and **Gam Nguyen** and **Jeffrey Wieselthier** of the Naval Research Laboratory received U.S. Patent 7,233,584 for the invention, "Group TDMA frame allocation method and apparatus."

The invention is a method and device that improves multiple-access capability for multihop wireless networks with multiple destinations and randomly generated traffic. User nodes are divided into groups in a way that provides increased throughput. A technique that optimizes the allocation of slots to these groups in periodically recurring frames is also included. This achieves maximum throughput and reduces the energy needed for each successfully transmitted packet.

Both Wieselthier and Nguyen earned Ph.D.s in electrical engineering from

the University of Maryland. Ephremides advised Wieselthier and ECE Professor Emeritus **Lee Davisson** advised Nguyen.

## Plenary addresses



Rebecca Copeland

On Dec. 14, Professor **P.S. Krishnaprasad** (ECE/ISR) gave the Bode Lecture at the 46th IEEE Conference on Decision and Control in New Orleans. The

lecture is part of the honor Krishnaprasad received for winning the 2007 IEEE Control Systems Society Hendrik W. Bode Prize. The prize was developed by the society to recognize distinguished contributions to control systems science or engineering.

Krishnaprasad spoke on "Pursuit and Cohesion: in Nature and by Design," discussing the geometric patterns in certain pursuit and prey capture phenomena in nature, and suggesting sensorimotor feedback laws that explain such patterns. As his example, Krishnaprasad talked about recent research with echolocating bats conducted with **Kaushik Ghose, Timothy Horiuchi, Eric Justh, Cynthia Moss, and Viswanadha Reddy**.

Professor **John S. Baras** (ECE/ISR) gave three invited plenary addresses at conferences in the past several months. In June, Baras gave an invited plenary consisting of a three-hour set of lectures on "Security and Trust for Wireless Autonomic Networks" at the Med-Hoc-Net 2007 Conference in Corfu, Greece. Baras's lectures were part of the tutorial and Ph.D. student workshop program of the conference. Some 70 Ph.D. students from all over Europe attended the workshop and the tutorials. The workshop was spon-

sored by the European Union network of excellence "CONTENT: Excellence in Content Distribution network Research"; the TC6 Technical Committee 'Communications Systems' of the International Federation for Information Processing (IFIP); and the European Union IP FET project CASCADAS: "Bringing Autonomic Services to Life."

In the lectures, Baras covered tutorial aspects as well as promising directions for future research. In July, Baras delivered one of two plenary addresses at the 2007 European Control Conference (ECC'07) on the island of Kos, Greece. The address was on "Security and Trust for Wireless Autonomic



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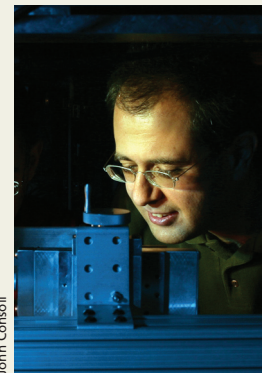
Networks: System and Control Methods." Baras summarized his work with ECE and ISR alumni **Alvaro Cardenas, Tao Jiang, Svetlana Radosavac and George Theo-**

**dorakopoulos**, on the formulation, analysis and solution of security, information assurance and trust in dynamic wireless networks problems. These include detection and defense against attacks, detection of propagating viruses, evaluation of intrusion systems, attacks at the physical, MAC and routing protocols, and trust establishment-dynamics-management. Baras has a copy of the talk on his web site, [www.isr.umd.edu/~baras](http://www.isr.umd.edu/~baras).

An invited paper, with the same title, describing the results in the lecture, was published in the special issue of the *European Journal of Control*, "Fundamental Issues of Control," EJC, Volume 13, Number 2-3, pp. 105-133, March-June 2007, and can be found at [www.elet.polimi.it/ejc/](http://www.elet.polimi.it/ejc/), or at [www.isr.umd.edu/~baras](http://www.isr.umd.edu/~baras).

In September, Baras gave one of five plenary addresses at the IFAC Conference on Control Applications in Marine Systems (CAMS'07) in Bol, Croatia. IFAC is the International Federation of Automatic Control.

His talk was titled, "Collaborative Control of Underwater Vehicles under Severely Limited Communications."



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Associate Professor **Reza Ghodssi** (ECE/ISR) will be one of the plenary speakers at DTIP 2008, the Symposium on Design, Test, Integration, and Packaging

of MEMS/MOEMS in Nice, France in April. The Symposium is sponsored by Circuits Multi-Projets, IEEE and the IEEE Components, Packaging and Manufacturing Technology Society.

The goal of the symposium is to provide a forum for interdisciplinary discussions involving design, modeling, testing, micromachining, microfabrication, integration and packaging of microstructures, devices and systems.

Ghodssi will speak on "Integrative MEMS/NEMS Technology for Micro and Nano Systems," presenting an overview of the process technologies developed by his research group in the MEMS (Micro-Electro-Mechanical Systems) Sensors and Actuators Lab.



## Distinguished lectures



**Tony Ephremides** (ECE/ISR), the Cynthia Kim Eminent Professor of Information Technology, gave three international lectures in December. Ephremides (at right in the photo above) is one of the IEEE Communication Society's Distinguished Lecturers, and gave three invited talks on "Cross-Layer Design in Wireless Networks."

He traveled to IEEE chapters in Kolkatta, India on Dec. 18; Kuala Lumpur, Malaysia on Dec. 20; and Jakarta, Indonesia, on Dec. 22. In India, the location was the WIPRO campus outside the city of

Kolkatta. WIPRO (West India Products) is a large diversified multicompany of high tech and other products. In Malaysia and Indonesia, Ephremides spoke at local universities.

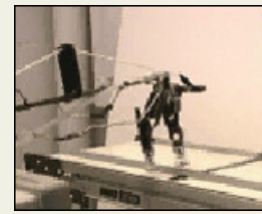
## Editorial board



Assistant Professor **Nuno Martins** (ECE/ISR) has joined the editorial board of *Systems & Control Letters*, one of the leading journals in systems and control. The journal

publishes a wide range of contributions, including mathematically oriented papers as well as papers describing specific applications of systems and control research in the areas of engineering, economics, the physical sciences, and signal processing.

## In the news



Professor **Avis Cohen** (Biology/ISR) and ISR-affiliated Associate Professor **Ralph**

**Etienne-Cummings** (Johns Hopkins University) continue to make the news for their work on lamprey spinal cords.

*WIRED* magazine profiled their work in the article "Lamprey May Offer Paralysis Cure."

The pair has developed a chip modeled on the lamprey spinal cord that contains a silicon analog of spinal circuits. The chip can control a walking robot. Feedback from the joint angles and footfalls of the robot are incorporated to train networks of neurons in the spinal cord called central pattern generators to recognize the correct frequency and phase relationship between limbs that is necessary for smooth and natural motions.

# alumniNEWS

## New faculty positions

Former ISR postdoctoral researcher

**Mounya Elhilali**

has begun a faculty position in the Electrical and Computer Engineering Department of Johns Hopkins University. The assistant professor position started in January 2008.



Elhilali earned her Ph.D. in Electrical Engineering at the University of Maryland in 2004. Her advisor was Professor **Shihab Shamma** (ECE/ISR), with whom she also worked during her postdoctoral appointment. She conducted research on the analysis of physiological experiments in the

auditory cortex and models of auditory scene analysis.

Elhilali's research interests include a study of auditory perception and learning (adaptive plasticity in auditory processing), as well as modeling work that relates neurophysiological findings of auditory processing to various signal processing applications, including assessment of speech intelligibility, computational auditory scene analysis and auditory streaming.

Two Ph.D. students advised by Professor **Tony Ephremides** (ECE/ISR) began their academic careers last fall.

**Azadeh Faridi** joined the Universitat Pompeu Fabra (Department de Tecnologia) in Barcelona, Spain, as a faculty member after her graduation in August. With Dr.

Ephremides she worked on cross-layer distortion control for delay-sensitive sources. Her research interests are in communication networks and information theory, with a focus on cross-layer design.

**Tolga Girici** joined the faculty of the Tobb University of Economics and Technology (Department of Electrical and Electronic Engineering) in Ankara, Turkey. He will be working on topics related to resource allocation, queueing theory and optimization in wireless multiple access and energy efficient communications in the near future.

Ephremides said, "I consider their accomplishment not only as a rewarding step for their careers but also as a step in radiating the UMD influence worldwide."

## Alumnus George Kantor and the DEPTHX underwater robot project

In 2007, both *IEEE Spectrum* magazine and the *Washington Post* highlighted a multi-university research project in which ISR



George Kantor with the daily plan for the underwater diving trials in La Pilita, Mexico.

alumnus George Kantor plays a key role. Kantor is a systems scientist at Carnegie Mellon University's Robotics Institute and works in its Field Robotics Center.

The Deep Phreatic Thermal Explorer (DEPTHX) project is a \$5 million, three-year, NASA-funded research effort. In addition to Carnegie Mellon, collaborators include the University of Illinois at Chicago, the University of Texas, the Colorado School of Mines, Southwest Research Institute, Stone Aerospace, Universidad de Nuevo Leon (Mexico) and Universidad del Noreste (Mexico).

The project's primary objective is to use an autonomous underwater vehicle (AUV) to explore and characterize the unique biology of Mexico's El Zacatón, the world's deepest known limestone sinkhole. This water-filled cavern is at least 300 meters deep and geothermally heated with a high sulfur content. It also lacks sunlight and dissolved oxygen. It's an ideal place to search for exotic microbial life.

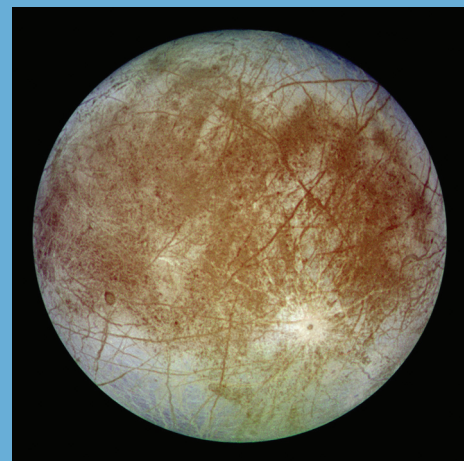
NASA hopes the robotic explorations and searches for microbial life in El Zacatón will help them develop a robot that can search for life in the liquid water ocean beneath the frozen surface of Jupiter's moon Europa.

DEPTHX is a hovering AUV that can



Student John Kerr unhooks the DEPTHX robot from its lifting slings.

explore flooded caverns and tunnels while building 3D maps, collecting environmental data, and obtaining samples from the water column and cavern walls. Because it is autonomous, DEPTHX makes its own decisions: where to swim, which samples to collect, and how to find its way home. It chooses the most interesting biological areas where temperature, oxygen levels or other characteristics change. The vehicle is equipped with a Doppler velocity logger, a ring laser gyro-based inertial navigation system, a depth sensor, and 54 narrow beam sonar transducers. DEPTHX uses all of these resources together to perform



NASA photo

DEPTHX could someday explore the liquid water ocean under the frozen surface of Jupiter's moon Europa.

simultaneous localization and mapping. Kantor's research contributes to the robot's control, mapping and navigation systems.

Kantor earned his Ph.D. in Electrical and Computer Engineering from the University of Maryland in 1999. His advisor was Professor P.S. Krishnaprasad (ECE/ISR). At Carnegie Mellon, Kantor teaches courses in robotic manipulation and controls and conducts research in control, sensing, and navigation for robotic systems. Kantor gave a talk on DEPTHX at ISR in February 2006. You can read the *Washington Post* article online at [www.washingtonpost.com/wp-dyn/content/article/2007/05/13/AR2007051300989.html?hpid=artslot](http://www.washingtonpost.com/wp-dyn/content/article/2007/05/13/AR2007051300989.html?hpid=artslot).



DEPTHX illuminates an old pump that had fallen into the water more than 50 years ago. George Kantor is swimming next to the robot.



## Andrew Newman wins Hart Prize

Alumnus **Andrew Newman** has won the Hart Prize for Excellence in Development from the Johns Hopkins University Applied Physics Laboratory. He received the prize for his role as principal investigator on the project, "Development: Tactically Responsive Intelligence, Surveillance, and Reconnaissance Management" (TRIM).

Newman graduated with a Ph.D. in Electrical and Computer Engineering in 1999. His advisor was Professor **P.S. Krishnaprasad** (ECE/ISR).

Newman's TRIM project developed a prototype for automated collaborative dynamic retasking of a heterogeneous ensemble of intelligence, surveillance, and reconnaissance platforms and sensors.

The Hart Prize honors the Applied

Physics Lab's Dr. R.W. Hart. Two annual prizes are granted, one each for the best research and the best development project.

## Mehdi Kalantari Khandani receives NSF grant

ECE Research Scientist **Mehdi Kalantari Khandani**, (Ph.D. Electrical and Computer Engineering 2005), has received a three-year National Science Foundation (NSF) grant for his research on "Information Flow Theory in Dense Wireless Networks."

Future wireless networks will be largely composed of a massive number of nodes densely distributed in large geographical areas. Careful analysis of these networks reveals a prohibitive level of complexity due to the uncoordinated interactions between each pair of nodes in the network.

Khandani's methodology models a dense wireless network by a continuum of nodes. The spatially continuous model of information flow promises to overcome the prohibitive complexity of conventional discrete space methods, an important step towards developing a theory of information flow in dense wireless networks. This is the wireless networking counterpart of the classical flow theory of other branches of science and engineering such as fluid dynamics, heat exchange, and electrostatics.

Khandani received his Ph.D. in electrical engineering at the University of Maryland in 2005. His advisor was **Mark Shayman**.

### Alumni: share your news with us!

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

# industryNEWS

## Agilent funds Austin infrastructure research

ISR-affiliated Associate Professor **Mark Austin** (CEE) has received funding from the Agilent Technologies Foundation for research in backbone infrastructure for system of systems management. ISR MSSE alumni **Scott Selberg**, system architect at Agilent Technologies, used his knowledge of ISR faculty research expertise to build a partnership between the two organizations. Selberg identified a need within Agilent, knew Austin had expertise to address this issue, and used the Agilent Technologies Foundation to provide funding support for this work.

## Okamoto visits from Toshiba

**Yosuke Okamoto**, an engineer from Toshiba Corporation in Japan, is at ISR for a six-month residence as a visiting scholar.

Mr. Okamoto works in the Quality Control System Technology Center at the Corporate Manufacturing Engineering Center in the

city of Yokohama. During his stay, Mr. Okamoto is involved in collaborative research with Professor **Yiannis Aloimonos** (UMIACS) in computer vision and image processing software.

## Amar Vadlamudi speaks on QoS management

Though QoS management is a well-understood technique in the communications infrastructure for real-time packet delivery, it has a long way to go in the practical systems engineering of real world distributed systems. Former ISR Computing Services Director **Amar**



Rebecca Copeland

**Vadlamudi** spoke on this issue at ISR in February. Vadlamudi is the Chief Operating Officer of System/Technology Development Corp. His expertise is focused on the application of research results into practical systems engineering.

## Walsh speaks about laser scanning systems

Former ISR faculty member **Greg Walsh** spoke to ISR about Leica Geosystems' LIDAR scanning systems, which solve commercial measurement problems. The laser scanners create metrologically accuracy 3D point clouds over spaces on the order of 100 meters. The images are used in a wide number of industries including processing plants, factory floors, accident scenes, and even movie sets. Walsh is vice president of systems engineering for Leica Geosystems' High Definition Surveying (HDS) division in San Ramon, Calif., where he has the joint role of research and development manager and system architect for Leica laser scanners.





## A symposium in honor of ISR Founding Director John Baras

All are invited and welcome to attend "From system theory to systems engineering: A symposium in honor of John Baras." This special celebration will be on Saturday, April 12, at the Inn and Conference Center on the campus of the University of Maryland in College Park, Md.

The cost for the full-day symposium is \$120. There is also an optional evening banquet; the cost is \$50.

The program features many of Dr. Baras's colleagues and friends, including:

- Roger Brockett, Harvard University;
- Pravin Varaiya, University of California, Berkeley;
- Sanjoy Mitter, Massachusetts Institute of Technology;
- Alain Bensoussan, University of Texas at Dallas;
- Lennart Ljung, Linköpings Universitet, Sweden;
- John Kenyon, Hughes Network Systems;
- Joseph Lawrence, Office of Naval Research.

Several of Dr. Baras's former students are also scheduled to speak in his honor.

**Register online at**  
**[www.isr.umd.edu/baras\\_](http://www.isr.umd.edu/baras_symposium/)**  
**[symposium/](http://www.isr.umd.edu/baras_symposium/)**

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