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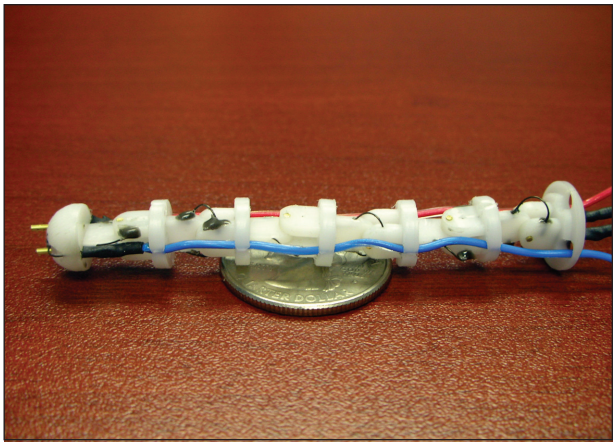
SYSTEM SOLUTIONS
THE INSTITUTE FOR SYSTEMS RESEARCH

The Institute for Systems Research

INSIDE

Gupta team wins physical science Invention of the Year

Gupta, Rubloff also finalists for software, nanotube inventions



The minimally invasive neurosurgical intracranial robot allows neurosurgeons to remove a brain tumor or mass while the patient is undergoing brain imaging.

Professor S.K. Gupta (ME/ISR) is part of an interdisciplinary team that won the 2008 University of Maryland "Invention of the Year" award in the physical science category. The researchers developed a robot that allows neurosurgeons to dissect brain tumors with minimal disturbance to brain tissue.

In addition to Gupta, the team includes Jaydev P. Desai (ME), Marc J. Simard, University of Baltimore Department of Neurosurgery, Rao Gullapalli, University of Baltimore Department of Radiology, and graduate students Nicholas Pappafotis and Wojciech Bejgerowski.

Brain tumors, which occur in 20-40 percent of adult cancer patients, are among the most feared complications of the disease. Despite advances in treatment, prognosis is poor, with a median survival of 4-8 months. This is primarily because there isn't good continuous imaging during surgery and because the complete tumor often is not removed due to its placement and the space constraints in reaching it.

Use of magnetic resonance imaging (MRI) during surgery can supplement the surgeon's visual and tactical senses in a way that other imaging devices have not achieved, resulting in less trauma to surrounding healthy brain tissue during surgery.

The minimally invasive neurosurgical intracranial robot developed by the Gupta team allows a neurosurgeon to remove brain tumors and other intracranial masses in patients while they are undergoing brain imaging. The highly dexterous robot performs this function while operating through an extremely narrow corridor in the brain, with minimal disturbance and damage to normal brain tissues.

The robot is made of materials that are entirely compatible with MRI. Because the neurosurgeon directly controls the robot with a virtual interface to the MRI, he or she does not

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Abshire, Shapiro, Smela collaborate on cell-based sensors

A small, unmanned vehicle makes its way down the road ahead of a military convoy. Suddenly it stops and relays a warning to the convoy commander. The presence of a deadly improvised explosive device, or IED, has been detected by sophisticated new sensor technology incorporating living olfactory cells on microchips mounted on the unmanned vehicle. The IED is safely dismantled and lives are saved.

This scenario may become a reality, thanks to Associate Professors **Pamela Abshire** (ECE/ISR) and **Benjamin Shapiro** (AE/ISR), and Professor **Elisabeth Smela** (ME/ECE). The trio are collaborating on technology that can take advantage of the sensory capabilities of biological cells.

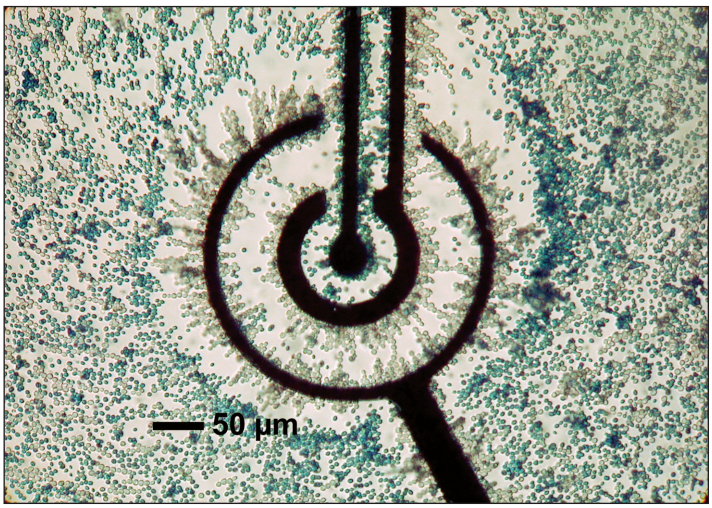
"Cell-based sensors on a chip," only a few millimeters in size, could speed up and improve the detection of everything from explosive materials to biological pathogens to spoiled food or impure water.

Today's biochemical detectors are slow and produce an unacceptable number of false readings. They often cannot distinguish subtle differences between deadly pathogens and harmless substances, and cannot fully monitor or interpret the different ways these substances interact with biological systems.

To solve this problem, the researchers are perfecting how to incorporate real cells into tiny microsystems to detect chemical and biological pathogens.

Cells can be cultivated on these chips for different purposes. A chip containing a collection of olfactory cells plus sensing circuits that can interpret their behavior could detect the presence of explosives. Other specialized cells would show stress or die when exposed to pathogens, triggering a quick and accurate warning.

Many challenges must be met for these chips to become a reality. Abshire is building circuits that interact with the cells and transmit alerts about their condition. Shapiro and Smela are working on microfluidics to move the cells into place and keep them healthy. Smela also is developing packages that incorporate the kind of wet, life-sustaining environments the biological components need, while keeping the sensitive electronic parts of the sensor dry.



Live (clear) and dead (blue) yeast cells patterned by means of alternating electric fields. Fields at different frequencies were applied between the pairs of electrodes shown to separate the cells.

Funding comes from the National Science Foundation, the Department of Homeland Security and the Defense Intelligence Agency. However, potential applications extend well beyond national security.

The sensors could uncover the presence of harmful bacteria in food, or detect the local origin of specialty foods like cheeses or wines. In the pharmaceutical industry they could identify the most promising medicines in advance of animal and human trials, increasing cost-effectiveness and speed in developing new drugs.

"We bring the capability to monitor many different cells in parallel on these chips," explains Abshire. "You could say we're applying Moore's Law of exponentially increasing computer processing capability to cell biology."

A patent application is on file with the U.S. Patent and Trademark Office. ≡S

Handheld pathogen detector grant

Abshire, Shapiro and Smela are partnering with Innovative Biosensors, Inc. (IBI) on a $1.8 million grant to develop a handheld device for detecting pathogens. The grant comes from the National Consortium for Measurement and Signatures Intelligence (MASINT) Research NCMR. "Handheld Cell-Based BioSensor for Complex Samples" will develop a miniaturized analysis system that could be used in industrial, environmental and clinical fields.

The living cells will be exposed to potential pathogens in the air via a semi-permeable membrane. The 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 quickly realizes pathogens are present. The cells are stored on a chip that keeps them alive and monitors the light they produce.

IBI develops rapid, ultra-sensitive tests to detect harmful pathogens for both the biodefense and clinical infectious disease markets. IBI began at the University of Maryland's Technology Advancement Program Incubator. ≡S

major AWARDS

NIH: Auditory cortex research

ISR-affiliated Associate Professor **Jonathan Simon** (ECE/Biology) received a five-year, $1.2 million National Institutes of Health grant for "The Neural Basis of Perceptually-Relevant Auditory Modulations in Humans." The research will explore how acoustic modulations, the building blocks of speech and other natural sounds, are encoded in the auditory cortex. Simon will use magnetoencephalography and extracellular recording to investigate how temporal modulations are encoded by the auditory cortex in the brain.

MURI: Multi-scale networks

A research team that includes Professors **John Baras** (ECE/ISR) and **Tony Ephremides** (ECE/ISR) has won a three-year, $6 million, 2008 Multi-University Research Initiative (MURI) award for "MAASCOM: Modeling, Analysis, and Algorithms for Stochastic Control of Multi-Scale Networks." The University of Maryland portion is $1 million. The project will be coordinated by Baras and Ephremides with partnering teams at Ohio State University, MIT, the University of Illinois, and Purdue University. The group's research deals with multiple time scales, traffic characteristics, and control of communication networks.

AFOSR: Mobile multi-agent systems control

Assistant Professor **Nuno Martins** (ECE/ISR) has received a three-year, $270,000 grant from the Air Force Office of Scientific Research (AFOSR) for "Networked Guidance and Control for Mobile Multi-Agent Systems: A Multi-terminal (network) Information Theoretic Approach." This research will develop computationally efficient methods for the joint design of guidance/control and wireless communication modules for multi-agent networked control systems. Martins will develop optimal guidance/controller design methods that allow for new types of specifications involving the rates of data transmission among agents in the presence of interference and transmission power constraints. These modules could find use in unmanned aerial vehicles (UAVs), where it is crucial to have guaranteed interagent rates of data transmission.

NASA: Constellation program

NASA's Constellation Program has selected 11 companies and the University of Maryland to independently develop concepts that contribute to how astronauts will live and work on the moon. The awards total approximately $2 million, with a maximum individual award of $250,000. Each organization will conduct a 180-day study focused on a topic relevant to lunar surface systems. ISR-affiliated Associate Professor **Dave Akin** (AE) is Maryland's principal investigator, focusing on minimum habitation functions. Akin is director of the Space Systems Laboratory.

NSF: Compiler optimization

Associate Professor **Rajeev Barua** (ECE/ISR) is the principal investigator and Professor **Uzi Vishkin** (ECE/UMIACS) is co-PI of a three-year, $400,000 National Science Foundation (NSF) grant, "Compiler-Directed System Optimization of a Highly-Parallel Fine-Grained Chip Multiprocessor."

This project will study compiler optimizations for the XMT multiprocessor developed by Vishkin. The desktop supercomputing prototype is capable of speeds 100 times faster than current desktops.

The project will develop new compiler technologies for XMT to achieve scalable performance in the face of architecture decisions made for scalability. These include better task schedulers using global queues rather than work stealing, improved pre-fetching tailored for XMT's unique memory hierarchy, and using scalable non-cache-coherent scratch-pad memory local to each XMT processor to reduce the need to go to expensive remote memory.

NSF: Modeling mobile wireless networks

Professor **Armand Makowski** (ECE/ISR) is the principal investigator and Associate Professor **Richard La** (ECE/ISR) is the co-PI for the NSF grant, "Towards Modeling Mobile Wireless Networks—When Connectivity Meets Mobility." The three-year, $260,000 grant will explore how different notions of network connectivity shape resource allocation in the presence of node mobility.

The researchers will introduce the notions of continuous connectivity and fly-through connectivity and explore how different notions of network connectivity shape resource allocation (e.g., energy) in the presence of node mobility.

NSF: Nanoscale assembly

Professor **S.K. Gupta** (ME/ISR) is the principal investigator for an NSF CDI-Type 1 grant, "High-Performance Simulations and Interactive Visualization for Automated Nanoscale Assembly." The three-year, $550,000 grant will develop a fundamental understanding of the interaction of nanocomponents with trapping fields. Amitabh Varshney (CS) is the co-PI.

Manipulation techniques for nanocomponents lack automation, limiting the rate at which new nanocomponent-based devices can be invented. Developing an understanding of the interaction of nanocomponents with trapping fields will aid the development of automated real-time planning algorithms. This will lead to a reliable, efficient, and automated assembly process for fabricating nanocomponent-based devices, making the manufacturing of nanodevices more cost-competitive.

continued on page 4...

Major awards

... continued from page 3

NSF: Multivariate polynomials; nano device coding

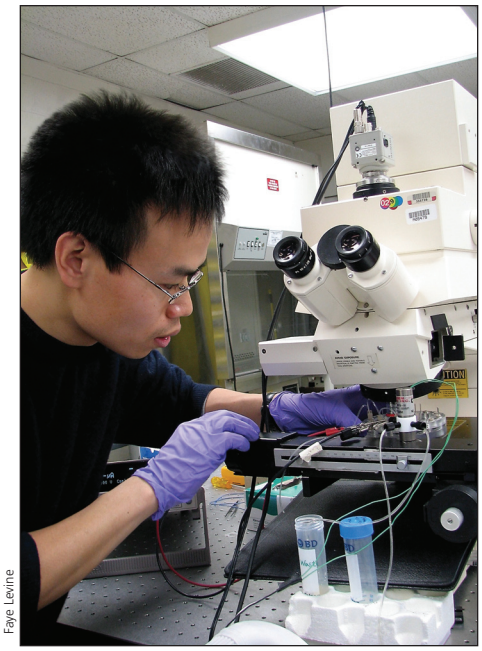
Professor **Alexander Barg** (ECE/ISR) is the principal investigator for an NSF Collaborative Research grant, "Multivariate positive definite polynomials and their applications via SDP." The three-year, $114,000 grant will study point allocations on the real sphere and related configurations using methods of distance geometry, coding theory, and semidefinite programming. The research has applications to communication theory, numerical analysis, the meshing problem, data representation, and localization in sensor networks.

Barg also is the PI for another Collaborative Research grant, "Coding for Nano-Devices, Flash Memories, and VLSI Circuits." The three-year, $299,000 grant will explore applications of coding theory to digital circuit design, particularly next-generation memory nano-devices such as the nano-wire crossbar.

NSF: Common randomness

Professor **Prakash Narayan** (ECE/ISR) is the principal investigator for an NSF grant, "Common Randomness, Multiuser Secrecy and Tree Packing." The three-year, $400,000 grant will take a multiuser information theoretic approach to investigate innate theoretical connections that exist between multiuser source and channel coding, information theoretic network security, and combinatorial tree packing algorithms in theoretical computer science.

The research will develop information theoretic principles for signal processing algorithms. It will apply source coding and channel coding techniques for providing information theoretic network secrecy in encrypted communication, and investigate points of contact between combinatorial tree packing algorithms and network security. ≡S



Faye Levine

Graduate student Xiaolong Luo works on the drug-testing chip.

Drug research microchip developed

A cross-disciplinary research team has shown for the first time that a microscopic platform can produce the chemical reactions needed to test drugs.

After researchers placed an enzyme on a tiny biochip that mimics the environment within the human body, the enzyme performed as it normally would. This means that the researchers can proceed to the next step—testing new drugs to see how effectively they can inhibit bacteria like *E. coli*.

The chip is a programmable biological microfactory, which will be used to test drugs and eventually deliver them where they are needed.

"We have now demonstrated the key advance needed to realize what we seek, a powerful laboratory tool for drug discovery," said Professor **Gary Rubloff** (MSE/ECE/ISR), director of the Maryland NanoCenter.

The microfactory allows the researchers to manipulate substances using fluid, electrical and optical means. For instance, the researchers used electrical voltage to place a substance called chitosan on the biochip. Chitosan serves as a platform for assembling biomolecules.

One targeted application of the microfactory is to develop drugs that can interrupt a process called "quorum sensing." In quorum sensing, bacteria cells, such as *E. coli*, communicate with each other to form a quorum or group capable of creating an infection. The team has already demonstrated that it is possible to interrupt quorum sensing to introduce new communication that ultimately prevents such infections.

Candidate drugs will be applied in the microfactory to test how well they suppress or interrupt quorum sensing. Drugs that succeed are good candidates for new antibiotics, and promise a new strategy for antibiotic therapy.

Drugs that kill bacteria also stimulate them to mutate, rending many antibiotics ineffective over time. The microchips address this well-known problem. "On our microchips, the drugs won't kill the bacteria," Rubloff says, "so mutation will not be triggered."

The team envisions the use of programmable biological microfactories as tools for rapidly screening and developing new drugs prior to time-consuming, expensive clinical trials.

"Any lab screening that is faster or more efficient in identifying new drugs could also reduce drug costs and time to market," Rubloff said.

The research is funded by the Robert W. Deutsch Foundation and a $2 million NSF Emerging Frontiers in Research and Innovation grant awarded to Rubloff; **Greg Payne**, director of the UMBI's Center for Biosystems Research; Associate Professor **Reza Ghodssi** (ECE/ISR); and **William Bentley**, chair of the Fischell Department of Bioengineering. ≡S

STOP software predicts terror groups' reasoning and actions

ISR-affiliated Professor **V.S. Subrahmanian's** (CS/UMIACS) SOMA Terror Organization Portal (STOP) software can be used to suggest high-level strategies for dealing with major terrorist organizations. (SOMA stands for Stochastic Opponent Modeling Agents.) The data mining software helps predict how terror groups will act and share data through social networking. It provides methods for reasoning about terror groups and forecasting what they might do in the future. STOP contains unique social networking capabilities that allow analysts to cooperate more effectively to better understand and counteract terror groups.

"The software takes either a hypothetical or actual situation, and tries to predict how a group might act based on what has actually happened," Subrahmanian says. "We achieved accuracy on the order of about 90-plus percent... but the predictions are somewhat coarse-grained."

Subrahmanian is the director of the University of Maryland's Institute for Advanced Computer Studies (UMIACS). STOP research is conducted by UMIACS' Lab for Computational Cultural Dynamics.

You can read more about STOP in this online *Computerworld* article: *www.computerworld.com/action/article.do?command=viewArticleBasic&articleId=9064938&intsrc=hm_list.* ES

eMedCheck helps public health workers dispense emergency antibiotics

When dispensing antibiotics in an emergency situation, determining who should get which medication is an important question. But the rules can be confusing, and paper forms are not efficient.

Working closely with partners at the Montgomery County, Md., Advanced Practice Center for Public Health Emergency Preparedness and Response, a research team led by Associate Professor **Jeffrey Herrmann** (ME/ISR) has developed and released eMedCheck, an electronic medication screening form that can be run on a personal digital assistant (PDA) like a Palm Pilor or BlackBerry.

The screening form determines who should receive Doxy, Cipro, or neither medication. The decision rules used in eMedCheck are identical to those in a medication screening form developed by the National Capital Region.

You can download a free zip file that includes the user's guide, the installation guide, the medication screening form, and the software (which includes the application and a database). Instructions for downloading the software and installing it on a Palm PDA also are included. *www.isr.umd.edu/Labs/CIM/projects/clinic/emedcheck.html.* ES

studentNEWS

Galloway awarded summer research fellowship

This summer, Ph.D. student **Kevin Galloway** was awarded a University of Maryland Graduate Student Summer Research Fellowship. The fellowship provides mid-career support to doctoral students around the time of candidacy, enabling them to devote a summer of focused work to preparing for or completing a benchmark in their program's requirements.

Galloway is advised by Professor **P.S. Krishnaprasad** (ECE/ISR).

Undergrad wins technical writing prize

A paper written by 2007 ECE B.S. graduate **Imran Shamim** has taken first prize in the Technical Report category of the university's Professional Writing Program Annual Writing Contest.

Shamim's technical report was titled "Design, Simulation, and Layout of a Serial Digital-to-Analog Converter (DAC) Array for On-Chip, Analog Parameter Control."

Shamim was an undergraduate researcher in Associate Professor **Timothy Horiuchi's** (ECE/ISR) Computational Sensorimotor Systems Laboratory, working in analog VLSI design and is currently a graduate student at MIT.

Palathra, de Pilar Leon conduct research overseas

Two graduate students of Associate Professor **Ray Adomaitis** (ChEBE/ISR) participated in international research experiences this summer.

Thomas Palathra won an NSF grant under the East Asia and Pacific Summer Institutes for U.S. Graduate Students (EAPSI) program. He spent eight weeks working in the research group of Professor Arthur Tay at the National University of Singapore on modeling and control of

photolithography systems for microelectronics manufacturing.

Maria del Pilar Leon participated in the 2008 American Advanced Study Institute on Emerging Trends in Process Systems Engineering in Mar del Plata, Argentina. This institute brings graduate students, postdocs, and other researchers together for a workshop focusing on current topics in chemical process systems engineering. Financial support for the invited students was provided by NSF and the Department of Energy.

Robotics@Maryland wins international AUV contest

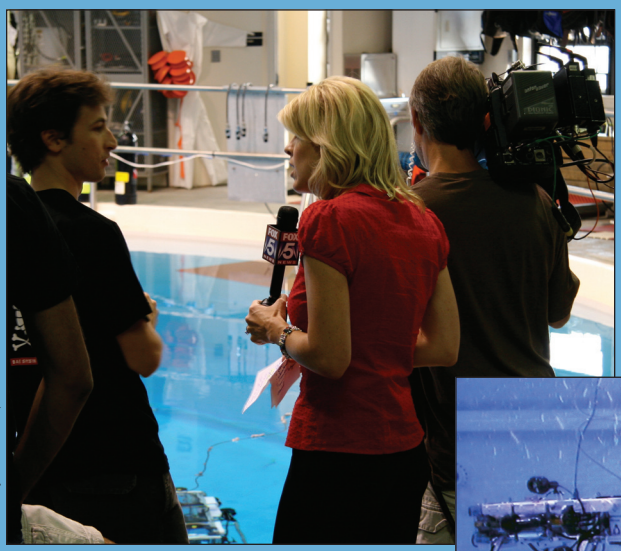
Tortuga II, an autonomous underwater vehicle (AUV) built by undergrads from the Robotics@Maryland team won the 11th Annual International AUV Competition in San Diego, Calif., this August. The contest was sponsored by the Association for Unmanned Vehicle Systems International and the Office of Naval Research. Robotics@Maryland has offices at ISR in the A.V. Williams Building and is advised by ISR-affiliated Associate Professor **Dave Akin** (AE) and Assistant Professor **Nuno Martins** (ECE/ISR).

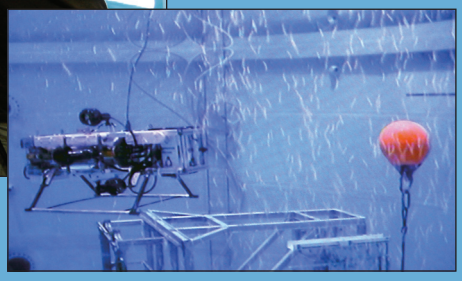
The 13-member team competed against 25 other teams from across the United States, India, Canada and Japan. Each team was challenged to design and build an AUV capable of navigating realistic underwater missions. The Maryland team won the competition in only its second year of participation.

"Despite losing our main vehicle computer, busting a thruster propeller, temporarily losing our firewire cameras, and watching three team members' laptops die, the group worked together and handled each problem in turn," said Joseph Gland, graduate student advisor for the team.

The team is made up of students from across the campus. Sponsors include ISR, the Department of Electrical and Computer Engineering, the Department of Aerospace Engineering, the Clark School of Engineering, and the UM Office of the Vice President for Research. It also receives corporate support from Clark School corporate partners BAE Systems, E.K. Fox and Apple. The team tests its vehicles in the Space Systems Laboratory's Neutral Buoyancy Research Facility (NBRF), a 50-foot diameter, 25-foot deep water tank used to simulate the microgravity environment of space.

The victory received wide press coverage; television station WTTG Fox 5 broadcast live from the NBRF in early September.

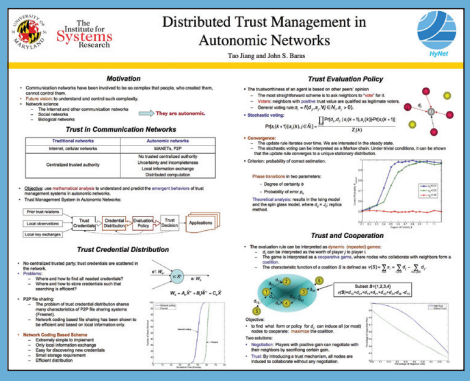




Photos by Rebecca Copeland

Robotics@Maryland students are interviewed on local television as Tortuga II zeroes in on an underwater target.

ISR student poster contest winners



Five student research projects were winners in the poster contest held at ISR's 2008 Systems Symposium. Our thanks to the symposium committee for their hard work and diligence in the judging. Congratulations to the students for this recognition of their research and their excellent poster presentations!

- **Distributed Trust Management in Autonomic Systems**
  Student: Tao Jiang; Advisor: John Baras
- **Analyzing Network Threats**
  Students: Robin Berthier, Daniele Chrun, Ed Condon, Keith Jarrin
  Advisor: Michel Cukier
- **Optimal Rate Control Policies for Proportional Fairness in Wireless Networks**
  Student: Anna Pantelidou; Advisor: Tony Ephremides
- **Topology-Aware Component Based Model for Performance Evaluation of Ad-Hoc Routing Protocols**
  Students: Vahid Tabatabaee, Punyaslok Purkayastha, Kiran Somasundaram, Shah-An Yang, George Papageorgiou
  Advisor: John Baras
- **Using Ration-by-Distance on Ground Delay Programs**
  Student: Charles Glover; Advisors: Michael Ball and Bob Hoffman

You can view all the 2008 posters online at www.isr.umd.edu/SS2008/posters.htm.

Microball bearings make miniature machines possible

Soldiers carry a heavy load. Imagine running hard in a desert environment toting some 100 pounds of weapons, body armor, simple medical supplies, food and water, and an array of digital communications and computing devices.

Every pound matters, including the 20 pounds of lithium ion and other batteries that power those digital devices.

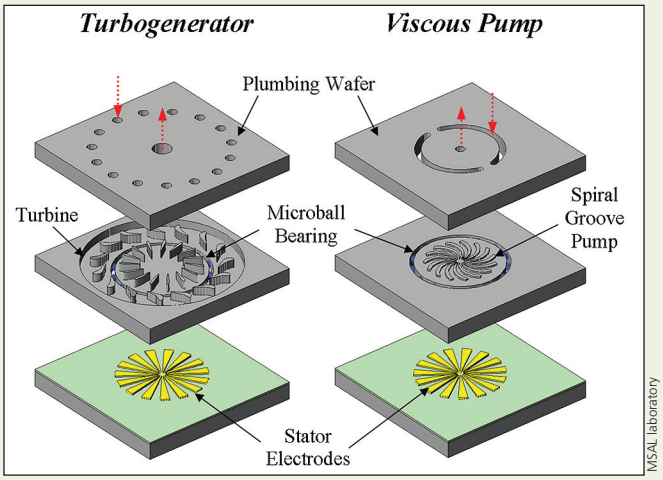
A team of researchers led by Associate Professor **Reza Ghodssi** (ECE/ISR) and funded by the U.S. Army Research Laboratory (ARL) and U.S. Army Research Office (ARO) has recently succeeded in manufacturing micromachines—tiny pumps, motors, and turbines that, integrated in a microscale liquid-fuel power generation system, will significantly reduce a soldier's battery load.

The engineers' advances also hold promise in technologies for health care (micropumps for implantable medical devices) and first responders (biochemical sensors).

"For the first time, we have achieved a level of miniaturization for machines like that achieved over the last decades in electronics," says Ghodssi. "Our work shows it is feasible to manufacture and integrate reliable, robust micromachines that apply tiny pumps, motors, and turbines in ways never before possible."

The central component of their research is the lowly ball bearing, an ancient technology now used in everything from jet engines to dentists' drills—devices in which parts move at high speeds in close proximity to each other. Ball bearings are simply spheres made of metal, silicon, or other substances, that when placed between two surfaces, such as the components of a motor or generator, allow those components to move with less friction and heat than if they were moving in direct contact with each other. The less friction and heat, the faster the components can spin and the more power they can produce.

Using well-known manufacturing techniques similar to those used in the semiconductor industry to make computer chips, the researchers have successfully miniaturized ball bearing support mechanisms with microballs as wide as a few human hairs and nearly invisible to the naked eye. Using these components, they have built tiny silicon pumps, motors, and turbines demonstrating rotational speeds of up to 87,000 rpm, comparable to the speeds of large-scale machinery.



MSAL laboratory

Schematic drawings of a micro turbogenerator and a viscous pump. Both use micro ball bearing technology developed by Ghodssi's team.

For troops on the battlefield, these small-scale combustion generators combined with batteries in hybrid technologies will significantly reduce the soldier's load.

Bruce Geil, ARL's acting branch chief for the Power Components Branch, says, "The Army needs small-scale, liquid-fueled power generators that can provide higher energy, at lighter weight and lower cost, than current fielded power sources. Dr. Ghodssi's team is developing key fuel delivery and electrical generator components to meet our requirements."

Micromachine systems also will help power land or air-based micro vehicles (also under development at the University of Maryland in partnership with government agencies) that will venture into risk-filled environments ahead of soldiers or first responders and send back information. Microgenerators fabricated completely in silicon and supported on microball bearings could power the vehicles' electrical systems without weighing them down.

To create their machines, Ghodssi and his team first had to conquer the science of microscale "tribology"—the friction, wear, and lubrication of tiny rolling components. They then applied this knowledge to building different types of micromachines using conventional manufacturing processes, and finally to integrating these devices into tiny systems that can reliably accomplish a task such as power generation over a reasonable period of time, and not simply burn up.

"Rather than focus on an arbitrary performance specification for micromachines," says Ghodssi, "we focused on feasibility—building pumps and motors that are fast enough to do the jobs required, reliable enough to last, and easy enough to manufacture in the real world. As in the miniaturization of electronics, we expect to achieve successive generations of higher and higher efficiency and refinement in micromachine systems, and to see the creation not only of new defense and medical products, but of entirely new technologies no one has yet imagined."

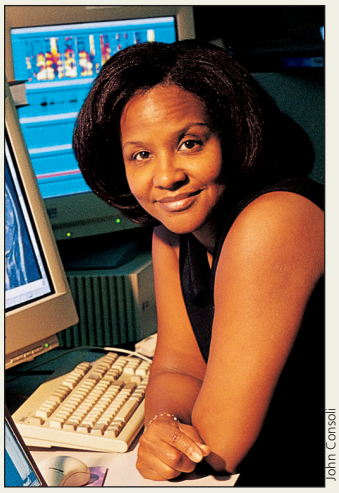
Additional information and videos of the power MEMS devices at work can be viewed on ISR's web site at *www.isr.umd.edu/news/news_story.php?id=3423*.

facultyNEWS

Awards and recognition


John Consoli

Associate Professor **Jeffrey Herrmann** (ME/ISR) is one of 24 winners statewide of the *Maryland Daily Record's* Innovator of the Year awards. Herrmann won the award for his Clinic Planning Model Generator (CPMG), an emergency preparedness planner used in state and county public health departments across the United States. He was nominated for the award by ISR. CPMG is a spreadsheet application that generates customized analytical models of mass dispensing and vaccination clinics.


John Consoli

Professor **Carol Espy-Wilson** (ECE/ISR) is in residence at Harvard University as a fellow of the Radcliffe Institute for Advanced Study for the academic year 2008–2009. She is part of a class of 50 international fellows representing 32 different academic, professional and artistic fields in creative arts, humanities, social sciences, natural sciences and mathematics. The year-long residency provides a focused atmosphere that fosters research.

Associate Professor **David Lovell** (CEE/ISR) and ISR-affiliated Associate Professor **Peter Sandborn** (ME) have been selected to join Keystone, the Clark School Academy of Distinguished Professors. Keystone instructors make a commitment to improving education in fundamental engineering courses. Keystone helps improve student retention and graduation rates by ensuring students the best learning experiences in the early, formative stages. Associate Professor **Guangming Zhang** (ME/ISR) was in the inaugural class of Keystone professors.

ISR-affiliated Professor **Ben Shneiderman** (CS) has won the College of Computer, Mathematical and Physical Sciences (CMPS) Board of Visitors Distinguished Faculty Award. The award is given annually to a tenured faculty member for outstanding accomplishments over the previous five years that have contributed significantly to raising the profile and visibility of CMPS.

Books

Associate Professor **S. (Raghu) Raghavan** (BMGT/ISR) is the co-editor of two new books. The first, published by Springer, is *The Vehicle Routing Problem: Latest Advances and New Challenges.* The other editors are Bruce Golden, the France-Merrick Chair in Management Science in the Robert H. Smith School of Business at the University of Maryland; and Edward Wasil, professor in the Kogod School of Business at American University in Washington, D.C. The book focuses on significant technical advances that have evolved during this period for modeling and solving vehicle routing problems and variants.

The second book, also published by Springer, is *Telecommunications Modeling, Policy, and Technology Series: Operations Research/Computer Science Interfaces Series, Vol. 44.* Co-editors are Bruce Golden and Edward Wasil. Each of the 17 papers in the

volume is motivated by advances in telecommunications technology. Issues include the design of business models, tools for spectrum auctions, Internet charging schemes, Internet routing policies, and network design problems.

Professor **S.K. Gupta** (ME/ISR) is co-author of the book, *Training in Virtual Environments: A Safe, Cost-Effective, and Engaging Approach to Training.* Additional authors are D.K. Anand, J. Brough, M. Schwartz, and R. Kavetsky. The book is published by CALCE EPSC at the University of Maryland, and reports on research in developing methodologies for training in virtual environments. It also provides an overview of the components of virtual environments.

Professor **Sandor Boyson** (BGMT/ISR) is the co-author of a chapter in the World Economic Forum's annual *Global Information Technology Report.* David Boyer, research scientist with Avaya Labs, is co-author. The book offers a blueprint for nations to better leverage emerging communications capabilities and technologies, spurring economic and social development.

Distinguished lectures

Professor **P.S. Krishnaprasad** (ECE/ISR) gave the inaugural distinguished lecture at the Cymer Center for Control Systems and Dynamics,

at the University of California San Diego. Krishnaprasad was invited to give the lecture by the center's director, Miroslav Krstic, formerly a professor in the University of Maryland's Mechanical Engineering Department and an affiliated faculty member of ISR. Krishnaprasad's lecture, "Pursuit and Cohesion: From Biology to Autonomous Vehicles," discussed the geometric patterns in certain pursuit and prey capture phenomena in nature. He also suggested sensorimotor feedback laws that explain the patterns. He focused on the echolocating bat's prey capture strategy and compared it with alternatives using a game theoretic setting.

ISR-affiliated Professor **Ben Shneiderman** (CS) was the Symbolic Systems Distinguished Speaker at Stanford University, speaking on "Information Visualization for Insight and Communication." During his visit, Shneiderman also spoke on "Visual Analytics for Collaborative Knowledge Discovery," "Creativity Support Tools: Individual and Social," and "Science 2.0: The Design Science of Collaboration."

In addition, Shneiderman gave a keynote speech at ACM SIGMOD PODS 2008, "Extreme Visualization: Squeezing a Billion Records into a Million Pixels."

Professor **Tony Ephremides** (ECE/ISR) has given several distinguished lectures in recent months.

He presented an invited distinguished lecture at the Digital Technology Center of the University of Minnesota, speaking on "Network Coding: A New Paradigm for Networking." His talk analyzed network coding in the context of both wireline

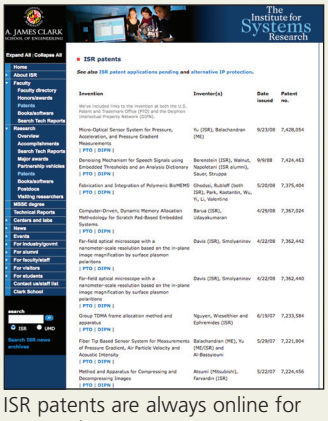
and wireless networks and examined technical roadblocks and applications. Ephremides also gave a distinguished lecture at Texas A&M University, "Cooperative Methods at the Network Level for Wireless Ad Hoc Networks" and an invited talk at the T. J. Watson IBM Research Center, "New and Exciting ideas in Wireless Networking—The Longer View."

He was the keynote speaker at a special IEEE International Information Theory Workshop in Porto, Portugal, speaking on "Beyond Shannon?" The workshop commemorated the 60th anniversary of the landmark paper by Claude Shannon which founded the field of information theory.

Professor **Dana Nau** (CS/ISR) was the invited speaker at ProMAS 2008, the Sixth International Workshop on Programming Multi-Agent Systems in Estoril, Portugal. He spoke on "Planning for Interactions among Autonomous Agents."

Patents

ISR-affiliated Assistant Professor **Miao Yu** (ME) and Professor **Balakumar Balachandran** (ME) have been awarded U.S. Patent 7,428,054 for "Micro-optical sensor system for pressure, acceleration, and pressure gradient measurements." The invention is a micro-optical fiber tip based sensor system for pressure, acceleration, and pressure gradient measurements in a wide bandwidth.



ISR patents are always online for you to view at our patents page, *www.isr.umd.edu/research/patents.htm.*

ISR-affiliated Professor **Mark Shayman** (ECE) and ECE Ph.D. alumnus **Mehdi Kalantari Khandani** ('05) have been awarded U.S. Patent 7,391,740 for "Method for quantifying responsiveness of flow aggregates to packet drops in a communication network." Shayman is the associate dean for faculty affairs in the A. James Clark School of Engineering, and Khandani is currently an assistant research scientist in the Electrical and Computer Engineering Department. Their invention can be used as a component in fair congestion control or in mitigating distributed denial of service (DDoS) attacks of the Internet.

Associate Professor **Rajeev Barua** (ECE/ISR) and ECE Ph.D. alumnus **Sumesh Udayakumaran** ('06) have been awarded U.S. Patent 7,367,024 for "Compiler-driven dynamic memory allocation methodology for scratch-pad based embedded systems." Their invention offers a highly predictable, low overhead and yet dynamic, memory allocation methodology for embedded systems with scratch-pad memory. The dynamic memory allocation methodology for global and stack data accounts for changing program requirements at runtime, has no software-caching tags, requires no run-time checks, and has extremely low overheads. The methodology also yields 100 percent predictable memory access times.

Associate Professor **Reza Ghodssi** (ECE/ISR) and Professor **Gary Rubloff** (ECE/ISR/MSE) are two of the inventors named on U.S. Patent 7,375,404, "Fabrication and integration of Polymeric bioMEMS." Other inventors include Jung Jin Park,

faculty NEWS

Mark Kastantin, Sheng Li, Li-Qun Wu, Hyunmin Yi and Theresa Valentine. The invention is a micro-electro-mechanical system (MEMS) device for microfluidic and/or biomicrofluidic applications.

ISR-affiliated Professor **Christopher Davis** (ECE) and ECE Visiting Research Scientist **Igor Smolyaninov** have been awarded U.S. Patents 7,362,440 and 7,362,442 for a far-field optical microscope. The invention is a powerful superlens with concentric rings of acrylic glass on a gold film surface, using advanced applications of plasmon technology. The plasmons—electron waves generated when light strikes a metallic surface—help reveal fine, nano-scale details previously undetectable. The lens can be used to see objects on the scale of small viruses.

Editorial boards

Assistant Professor **Nuno Martins** (ECE/ISR) has been appointed an associate editor to the IEEE Control Systems Society's Conference Editorial Board. Martins also has been named one of four guest editors for a special issue of *International Journal of Systems, Control and Communications* that focuses on interdisciplinary research in the theory and application of distributed control and communication systems.

Associate Professor **Reza Ghodssi** (ECE/ISR) has been named an associate editor for the IEEE/ASME *Journal of Microelectromechanical Systems* (JMEMS), the premier publication in the worldwide MEMS community. Ghodssi also has been named as an associate editor for the *Journal of Biomedical Microdevices*, the first journal to focus on biomedical applications of micro- and nanotechnology.

New faculty

Assistant Professor **Ankur Srivastava** (ECE/ISR) now holds a joint appointment with ISR. Srivastava's research interests are in VLSI design automation techniques, algorithms for low power and high performance integrated systems, VLSI fabrication variability and manufacturability, and low power sensing strategies for real time tracking applications.

Vahid Tabatabaee has joined the ISR faculty as an assistant research scientist. He received his Ph.D. (EE '03) from the University of Maryland and was advised by Professor **John Baras** (ECE/ISR) and former ISR faculty member **Leandros Tassiulas**. His research interests are in computer and communication networks with an emphasis on modeling wireless networks, designing optimal and robust protocols and algorithms for wired and wireless networks, distributed scheduling, and routing and resource allocation in wireless networks.

Associate Professor **Radu Balan** (Math/CSCAMM) has joined ISR as an affiliate faculty member. His research interests are in wireless network resource allocation, time-frequency operators, frames and computational mathematics.

Promotions and tenure

G. Anandalingam (BGMT/ISR) has been appointed dean of the Robert H. Smith School of Business. Anandalingam works in pricing, economics, design, and strategic issues in electronic markets and telecommunications networks.

S.K. Gupta (ME/ISR) has been promoted to full professor. Gupta's research interests lie in computer aided design, manufacturing automation, and robotics.

Associate Professor **Reza Ghodssi** (ECE/ISR) has been appointed Herbert Rabin Distinguished Professor. The four-year appointment recognizes his sustained and influential scientific and scholarly work.

Pamela Abshire (ECE/ISR) and ISR-affiliated faculty **Michel Cukier** (ME) and **Jonathan Simon** (ECE/Biology) have been promoted to Associate Professor with tenure.

Federal advisory committee

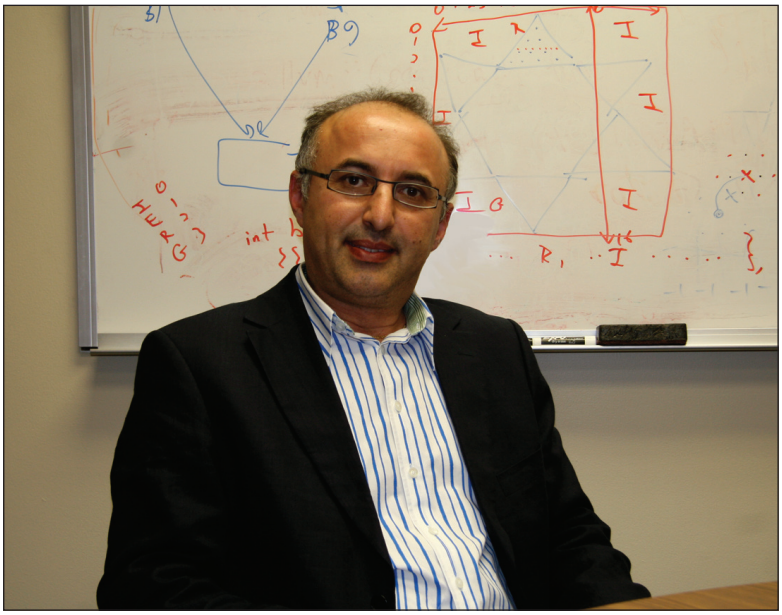
The U.S. Department of Commerce has appointed Associate Professor **Pamela Abshire** (ECE/ISR) to its new Emerging Technology and Research Advisory Committee (ETRAC). The committee will advise Commerce on the application of export controls to cutting-edge research and innovation.

Abshire is one of 24 members of the committee, which includes representatives from academia, industry, and federal government research laboratories. ETRAC is within the jurisdiction of the Department's Bureau of Industry and Security.

ETRAC will advise Commerce on identifying emerging technologies and research and development activities that may be of interest from a dual-use perspective; prioritizing new and existing controls to determine which are of greatest consequence to national security; assessing the potential impact of dual-use export control requirements on research activities; and determining the threat to national security posed by the unauthorized export of technologies.

"ETRAC will help ensure our export controls keep pace with technological developments, without stifling U.S. competitiveness, innovation, or security," said Under Secretary of Commerce Mario Mancuso. ΞS

Alumnus Reza Shahidi talks about his career in the wireless communication industry



Rebecca Copeland

When **Reza Shahidi** graduated from the University of Maryland in 1994 with a Ph.D. in electrical engineering, there was little hint of the trajectory his career would quickly take.

Shahidi had spent his academic years entirely at Maryland, earning a B.S. in 1985, and an M.S. in 1988 before receiving his Ph.D. with ISR-affiliated Professor **Mark Shayman** (ECE) as his advisor.

At Maryland, Shahidi minored in communication and electrophysics, in addition to his major work in control. He took classes in information theory and digital signal processing as well.

His M.S. thesis with Shayman and Professor **P.S. Krishnaprasad** (ECE/ISR) created algorithms for navigating mobile robots using potential functions.

His dissertation, "Active Vibration Damping by Parametric Control," explored controlling the stiffness of smart, flexible composite structures.

After graduation, Shahidi didn't work in control. He plunged into wireless communication, a field still in its infancy.

In town to headline an ISR alumni seminar this fall, Shahidi reminisced about the early days of his career and its progression thus far.

When Shahidi was in graduate school, professors like **Tony Ephremides** (ECE/ISR) were beginning to conduct nascent research in the area. But there were as yet few opportunities for engineering students to learn about the discipline at any university, anywhere. At that point only Virginia Tech had dipped its toe into cellular technology classes, Shahidi recalled.

"So I got a lot of on-the-job training," Shahidi said. "After I earned my Ph.D. I worked at the consulting firm LCC International in McLean as a technical instructor." The subjects he learned about, then taught to others, were wireless protocols, wireless and cellular networks.

Shahidi next became a design engineer with LCC. Working with Lucent, the LCC consultants helped develop Sprint's CDMA network in Massachusetts, the first in the state.

In 1997, Shahidi became a senior engineer at Qualcomm in its San Diego headquarters. He worked on systems engineering projects, CDMA and IS95 technology and was promoted to staff engineer.

Qualcomm sold its infrastructure division to Ericsson in 1999, and Shahidi worked there for the next six years, holding positions including director of engineering. When Ericsson closed its San Diego offices in 2005, Shahidi returned to Qualcomm, where he is currently a principal engineering manager.

Wherever his career has taken him, Shahidi has been grateful for his training in systems engineering.

"An understanding of systems engineering really helps me think in broad terms," Shahidi said. "In our industry we bring together different technologies and technology groups when we develop a new chip. There are people working on the RF component, the processor, the modem, the antenna, and so on."

"Each of these components is a specialty area, and each component has a cost. The more integrated a chip can be, the more components that are built in, the lower the overall cost. So it becomes a series of real systems engineering problems throughout the process of integrating these things with each other."

Shahidi said the skills of broad thinking and problem solving—which he learned at ISR—are extremely helpful in his job. "My job is to look at the functional interactions between the components on the chip," he said. "I make sure the components work together, and that the interface between them—how they communicate—is robust, to optimize their overall performance."

Systems engineering skills help Shahidi "make sure everything works together." ES

Pati, Wiser introduce new broadcast TV network

ISR alumni **Phil Wiser** (EE B.S. '90) and **Buno Pati** (EE B.S. '86, M.S. '88, Ph.D. '92) have created a new broadcast TV network called "Sezmi." The new network will deliver TV shows to most large U.S. cities for about half of the monthly cost of cable and satellite television.

Sezmi offers a user-friendly interface that allows customers to browse programs in a variety of different ways, using a remote and box roughly the size of a DVD player. Customers can access a variety of channels, such as CNN, FX, and HBO, and can also tune into web video from sites like YouTube. Sezmi also incorporates "TiVo"-style on-demand programming. Viewers can access programs based on different content zones that categorize the programs in different ways. Sezmi broadcasts most of its programming wirelessly over the air, as well as providing some shows via existing broadband connections.

Wiser is Sezmi's co-founder, chair and president. The company was formerly known as Building B. Previously, Wiser served as chief technology officer of Sony Corporation of America, where he led overall digital media business and technology strategy. He forged the groundbreaking deals with iTunes and pioneered the mobile music space during his tenure at Sony Music.

Pati is an experienced entrepreneur with an established track record of building a number of early-stage companies into successful businesses. He is co-founder and CEO of Sezmi. Pati founded Numerical Technologies and served as its president and CEO, leading the company through its successful initial public offering to its acquisition by Synopsys. Before co-founding Numerical, Pati was assistant professor of electrical engineering and computer science at Harvard University.

For more information about Sezmi, visit *www.sezmi.com*. ≡S

Best paper award

ECE alumnus **Onur Kaya** received a best paper award at the IEEE Wireless Communications and Networking Conference (WCNC) for "Achievable Rates for the Three User Cooperative Multiple Access Channel," a paper he co-authored with his student, Cagatay Edemen. Kaya is currently assistant professor in electronics engineering at Isik University in Turkey. He graduated from Maryland in 2005 with a electrical engineering Ph.D., advised by Associate Professor **Sennur Ulukus** (ECE/ISR).

ONR grant

Xiaobo Tan has received a $380,000 award from the Office of Naval Research to develop highly maneuverable "biomimetic" robotic fish. These robots will be based on biological principles and incorporate biomimetic electroactive polymers. Tan is an assistant professor in electrical and computer engineering at Michigan State University. He earned his Ph.D. in electrical engineering in 2002 and was advised by Professor **John Baras** (ECE/ISR) and Professor **P.S. Krishnaprasad** (ECE/ISR). This work will build on Tan's NSF CAREER Award work for "Dexterous Biomimetic Micromanipulation Using Artificial Muscles: Modeling, Sensing, and Control," which provided a sound knowledge base in electroactive polymers.

Faculty positions

Sasan Bakhtiari has joined the faculty of the University of New South Wales (UNSW) in Sydney, Australia. Bakhtiari earned an M.S. in Electrical Engineering under the supervision of Professor **André Tits** (ECE/ISR) in 2003. He continued his study at the University of Maryland, earning an M.A. in Economics in 2005 and a Ph.D. in Economics in 2008.

ISR alumnus **Sanjeev Khudanpur** (ECE Ph.D., '97) has been promoted to associate professor with tenure in the Department of Electrical and Computer Engineering at Johns Hopkins University (JHU). At Maryland, Khudanpur was advised by Professor **Prakash Narayan** (ECE/ISR).

Chuang earns Intel Achievement Award

Wen-Hsien Chuang (ECE Ph.D. 2005), a former student of Associate Professor **Reza Ghodssi** (ECE/ISR), has received an Intel Achievement Award (IAA). The IAA awards recognize the very finest individual or team accomplishments at Intel Corp. Wen-Hsien, an Intel employee since 2005, received the award as part of the Technology and Manufacturing Group, which was recognized for developing innovative silicon diagnostic solutions.

Kalantari is $50K business plan winner

Mehdi Kalantari, an ECE faculty member and 2005 Ph.D. alumnus advised by Professor **Mark Shayman** (ECE/ISR), placed second overall in the alumni category of the The Maryland Technology Enterprise Institute's 2008 $50K Business Plan Competition. His project, Resensys Inc., develops remote, wireless, distributed sensors that persistently monitor the structural health of bridges, massive commercial and residential buildings, and other civil infrastructures. Resensys' sensors are easy to install, ultra-energy-efficient, and environmentally friendly. ≡S

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. And thanks!

Sikorsky is new ISR strategic partner

Sikorsky Aircraft Corp. has joined ISR's Strategic Partners Program. Sikorsky is a world leader in designing, manufacturing and servicing military and commercial helicopters, fixed-wing aircraft; in spare parts and maintenance, repair and overhaul services for helicopters and fixed-wing aircraft; and in civil helicopter operations. Sikorsky collaborates with Professor **André Tits** (ECE/ISR) to research advanced algorithms for rotorcraft control. Alumnus **Vineet Sahasrabudhe** (Aerospace Eng. Ph.D. 1996), co-advised by Dr. Tits and Professor **Roberto Celi** (AE), is Sikorsky's technical lead.

Visiting Scholars program featured in *Maryland International*

Maryland International, published by the University of Maryland's Office of International Programs, features ISR's Visiting Scholars program in its fall 2008 issue.

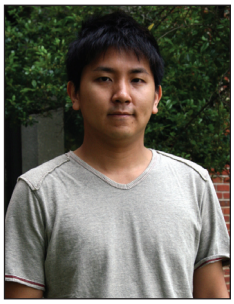
The Visiting Scholars program is now a decade old. Thirteen engineers from Toshiba and 12 engineers from Honda have spent extended periods of time at ISR, working with faculty on projects of mutual interest. ISR customizes each visit to meet the needs of the corporation and the individual visitor. Companies interested in learning more about the program can contact Jeff Coriale, ISR's director for external affairs at *coriale@umd.edu*.

View the article *at www.isr.umd.edu/industry/MDIntl.pdf.*

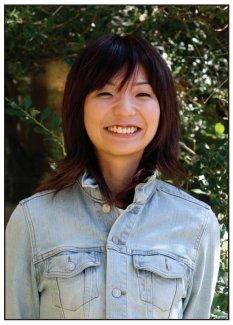
ISR's current Visiting Scholars

ISR's Visiting Scholars program provides engineers with an extended period of time to complete long-term research projects with faculty through their interaction and daily collaborations with ISR research groups. The engineers' experience is further enhanced through their immersion in local culture, language and business practices. Four Visiting Scholars are currently at ISR.

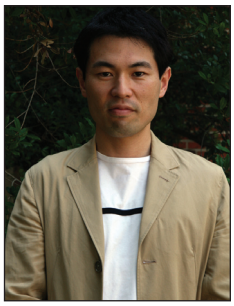
Photos this page by Rebecca Copeland



Mr. **Takeshi Yamanaka**, from Toshiba in Yokohama, Japan, is visiting for six months as an ISR Visiting Scholar. He is working with Professor **Balakumar Balachandran** (ME) in the Vibrations Laboratory on vibration reductions in production equipment.



Ms. **Mariko Sugimoto,** from Toshiba in Yokohama, Japan, is visiting ISR for six months and working with ISR-affiliated Research Professor **William Levine** (ECE) on vibration control in motors via modeling and simulation.



Mr. **Kensuke Iwanaga**, an engineer at Honda R&D Co. Ltd. in Saitama, Japan, is conducting research with ISR-affiliated Professor **Neil Goldsman** (ECE) for 14 months. His research involves device simulation for wide-bandgap semiconductor power devices.

Mr. **Tetsuaki Nakano** is an engineer at Honda R&D Co. Ltd. in Tochigi, Japan. He is conducting research with Professor **P.S. Krishnaprasad** (ECE/ISR) for 14 months on intelligent and robust control for robotic systems.

Mobile Manufacturers Forum funds Davis wireless research

Professor **Christopher C. Davis,** with his colleagues Dr. Quirino Balzano, Professor Robert Gammon, and Dr. Vildana Hodzic, has been awarded a contract by the Mobile Manufacturers Forum to develop a new method for measuring near-field energy absorption from wireless devices, especially mobile phones. The one year contract is for $293,000 with an optional extension of $115,000.

Davis and his colleagues are using a photo-thermal technique to measure the micro-degree temperature elevations produced in simulated humans (phantoms) by wireless devices. The deflections of multiple laser beams passing through a transparent phantom placed near the wireless device are measured immediately after it is turned on. This allows very rapid determination of the spatial distribution of absorbed energy in the phantom.

It is hoped that this new technique will replace current slow measurement methods that use electric field probes scanned by a robotic arm in three dimensions inside absorbing phantoms.

... continued from page 1

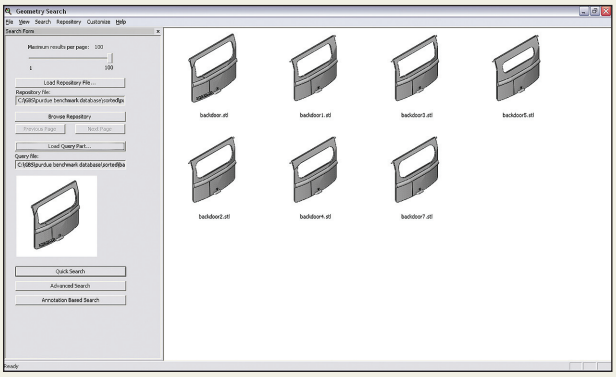
need to directly view the tumor during its removal.

The robot can manipulate instruments required to destroy tissues and remove tissue debris, including but not limited to monopolar and bipolar electrocautery, laser, radio-frequency ablator, ultrasonic cavitator, irrigation and suction. A U.S. patent application is pending.

Gupta's Geometry Based Search Software is information science finalist

S.K. Gupta also was a finalist in the information science category for his Geometry Based Search Software (GBSS). Also on the development team for this invention are research associates Antonio Cardone and Maxim Schwartz.

Three-Dimensional Computer Aided Drawing (3D CAD) systems are frequently used to generate models of parts and assemblies. Manufacturers routinely set up CAD model parts and assemblies databases to help them estimate manufacturing costs and reuse designs. For example, a database can be searched for similar parts, and their manufacturing costs can be used to estimate the cost of new parts.



Geometry Based Search Software can search for objects using 3-dimensional models instead of 2-dimensional images.

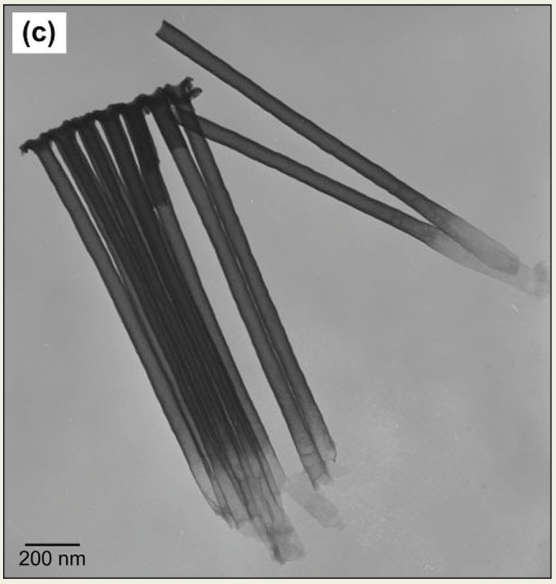
Current search software for these databases is inefficient and inaccurate. This is because the method is to project the 3D CAD model on two-dimensional planes to create 2D images, which are then compared with 2D images of the existing parts and assemblies. Further, available search filters in conventional software are not customizable by the end user.

GBSS overcomes these shortcomings with the ability to search for objects using 3D models rather than 2D images. The software can be used to perform quick cost estimation by finding similar designs and examining their costs. GBSS creates a repository of 3D CAD models for different parts, identifying each model with a unique signature. The signatures are extracted from a stereolithography file of the model and are stored in the database. A search query on the database is translated into these signatures and the database is then searched for the closest match.

GBSS then uses intelligent combinations of these signatures to give accurate results. The effect of each signature on the search results can be customized; a user can specify the weighting of each signature. GBSS provides both a quick and an advanced search that can be tailored to the user's specific needs. Overall, GBSS can offer more precise and time efficient control over manufacturing and design processes. A U.S. patent application is pending.

Rubloff's nanotube device is physical science finalist

A research team led by Maryland Nanocenter Director and former ISR Direcor **Gary Rubloff** (MSE/ECE/ISR) was a finalist in the physical science category for a lateral two-terminal nanotube device. Rubloff's team includes Sang Bok Lee, Chemistry and Biochemistry; and graduate assistants Parag Banerjee, Israel Perez, and Erin Robertson.



The lateral two-terminal nanotube device enhances the efficiency of energy capture, storage, and delivery.

The nanotubes can enhance the efficiency of energy capture, storage, and delivery for solar devices, capacitors and batteries, and thin film process technology, providing high performance energy and power systems at a modest cost.

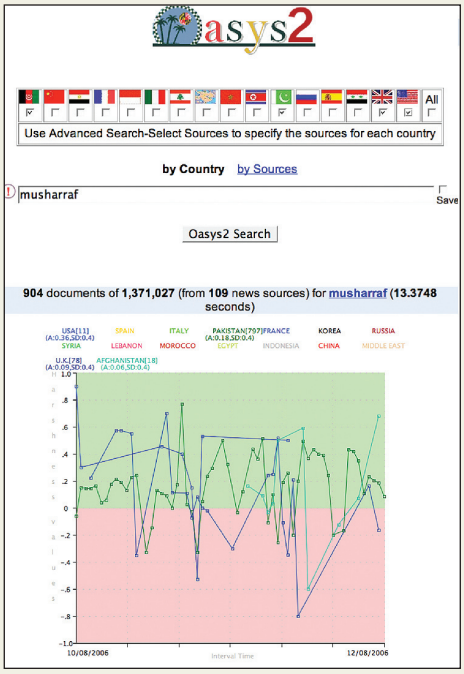
The devices are compatible with conventional thin film processing and with multilayers of lateral nanotube devices. The multilayer embodiments enable more efficient solar capture, tuning optical absorption in different layers to different parts of the spectrum. For energy storage, the structures promise high-burst power for distributed sensor/actuator systems and other applications. Finally, capture and storage layers may be vertically stacked and combined with control electronics to provide integrated energy systems on a single platform with a common fabrication and process technology. A U.S. patent application is pending.

The Invention of the Year awards are presented annually by the University of Maryland Office of Technology Commercialization to honor the university's outstanding inventions and inventors from the previous year. ES

Subrahmanian wins ISR Venture Fair

Want to know what the Web-based world thinks of you? Look no further than the winning technology of ISR's 2008 Faculty Venture Fair, sponsored by the University of Maryland's Office for Technology Commercialization and Maryland Technology Enterprise Institute (MTECH). The fair gives faculty inventors the opportunity to pitch their new technologies to a team of venture capitalists.

SentiMetrix technology measures and quantifies opinions expressed about a topic online in news sites, blogs, YouTube comments, and social networking sites. ISR-affiliated UMIACS Director **V.S. Subrahmanian** (CS/UMIACS) developed the technology in collaboration with postdoctoral fellow Diego Reforgiato and colleagues at Maryland and the University of Naples, Italy.



SentiMetrix's software can detect even relatively small changes in sentiment in real time.

"Our software can detect even relatively small changes in sentiment in real time," says Subrahmanian, who co-founded the university spin-off SentiMetrix Inc. in 2006 to commercialize the technology. "We can analyze how opinion changes over time. We are also the only company doing this in eight different languages, including Arabic, Chinese, Korean, Russian, French, Italian, Spanish and English."

For national security purposes, SentiMetrix could gauge what people around the world say about the U.S. "We can track how those opinions change," Subrahmanian explained, "as well as how they align towards the leaders we support." SentiMetrix's software recently accurately predicted the outcome of the election for prime minister in Italy.

In the business world, SentiMetrix can measure opinions about products, and can be used to correlate features with sales, which can then be used for pricing. Tracking a company's stock price versus what is being said about the stock over time is another potential application.

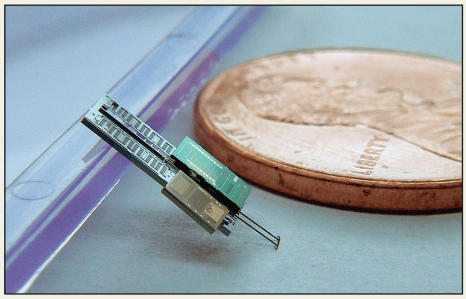
"The technology is compelling," says Mark Frantz, general partner of RedShift Ventures and a judge for the ISR Venture Fair. "SentiMetrix is going to be of interest to both new and established players in the rapidly growing Web 2.0 market, especially in the areas of online brand promotion and protection."

Privately financed, SentiMetrix has exclusive licenses on two overlapping technologies developed by Subrahmanian at the university, and has expanded these licenses through extensive R&D efforts since then. The company received $75,000 through the TEDCO Maryland Technology Transfer Fund in March.

SentiMetrix technology won *Computerworld's* 2006 Horizon Award, given to the most innovative pre-commercial technology.

Former AOL technologist Vadim Kagan is president of SentiMetrix.

Bergbreiter wins DARPA Young Faculty Award



Assistant Professor **Sarah Bergbreiter** (ME/ISR) has received a 2008 Young Faculty Award from the Defense Advanced Research Projects Agency (DARPA). The $150,000 award is given annually to 39 "rising stars in university microsystems research." The awards focus on innovative, speculative and high-risk concepts.

Bergbreiter is developing silicon/elastomer components for autonomous jumping microrobots." Jumping offers numerous benefits to millimeter-sized robots. As the robot size shrinks, obstacles around the robot grow comparatively larger and jumping provides a relatively simple mechanical means of dealing with those obstacles. The microrobot will be able to use other objects moving nearby to provide the locomotion power.

While the robot itself is simple, the components have performance requirements above those offered by current technologies. Bergbreiter will fabricate mechanisms like motors and springs in a silicon/elastomer process. This process will add an elastomer like PDMS into a standard SOI MEMS process to improve motor force density and spring performance. The goal is for the robot to be able to store and release enough energy to jump tens of centimeters. The silicon/elastomer process will also add robustness so that the robot will be able to land and jump again.

Aytekin, Moss, Simon write *Neural Computation* cover story

"A Sensorimotor Approach to Sound Localization," by ISR Postdoctoral Researcher **Murat Aytekin**, Professor **Cynthia Moss** (Psychology/ISR) and Assistant Professor **Jonathan Simon** (ECE/Biology) was the cover story of the March issue of the journal, *Neural Computation*.

Sound localization is a complex phenomenon, combining multisensory information processing, experience-dependent plasticity, and movement. The ISR trio demonstrated that the experience of the sensory consequences of its voluntary motor actions allows an organism to learn the spatial location of any sound source. Using examples from humans and echolocating bats, their model shows that an organism can learn the auditory space based solely on acoustic inputs and their relation to motor states.

Moss also recently was featured on a special National Science Foundation web page about the world of an echolocating bat and how bats navigate using sonar. She says there is more to studying bats than figuring out how they process sound to distinguish environments.

"We're now recognizing that every time a bat produces a sound there are changes in brain activity that may be important for scene analysis, sensorimotor control and spatial memory and navigation," she says.

The research could help neurobiologists understand mechanisms in the human brain and ultimately benefit human health.

View the NSF web page at *www.nsf.gov/news/news_summ.jsp?cntn_id=111763&org=NSF.* 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.

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