Systems Signals

ISR wins two Department of Defense MURIs

This spring ISR became a key participant in two new major Department of Defense MURI-97 (Multi-University Research Initiatives) awards, one establishing a Center for Auditory and Acoustic Research, and the other to investigate design and control of smart structures.

Center for Auditory and Acoustic Research

ISR and the University of Maryland at College Park are leading a consortium that is establishing a Center for Auditory and Acoustic Research. Professor Shihab Shamma (EE/ISR)

leads the project, along with Professor John Baras (EE/ISR), Professor P.S. Krishnaprasad (EE/ISR), Professor Steven Marcus (EE/ISR) and post-doc Didier Depireux. Faculty from the university's Mathematics, Zoology and Psychology departments are also involved.

This is an Office of Naval Research MURI on advanced acoustic processors for multiple Department of Defense applications. The award to the consortium is $1.2 million per year for three years, with the option of an additional two years.

The center will perform experimental and theoretical investigations of the auditory system and acoustic signal processing to gain fundamental understanding, invent new algorithms to capture functionality in software and hardware, and demonstrate validity of the research results on a wide range of Department of Defense-relevant applications.

The consortium also includes Boston University, the University of Maryland at Baltimore Medical School, the University of Washington, ETH/UZ in Zurich, and the University of California at Berkeley (in
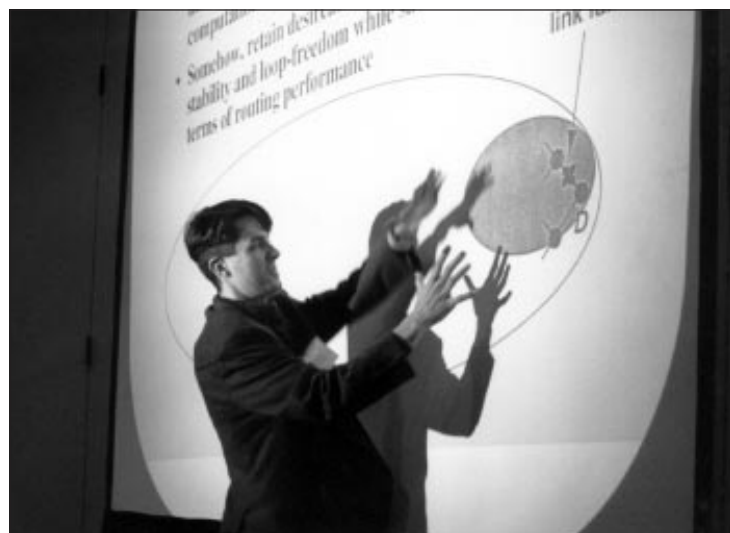
Workshop explores mobile ad-hoc communication networking

On March 14, ISR hosted an Army Research Office (ARO)/Defense Advanced Research Projects Agency (DARPA) workshop on mobile ad-hoc communication networking that drew 150 people from industry, the military and academia. This was more than twice the anticipated turnout.

ISR Assistant Research Scientist Scott Corson explains flat versus hierarchial network control architectures.

The workshop highlighted specific research being conducted by the ATIRP federated lab consortium. ISR Assistant Research Scientist Scott Corson chaired the event.

Topics included multimedia routing in mobile, distributed, wireless spread-spectrum radio networks,

routing for connectionless data delivery, flat versus hierarchical network control architectures, the Naval Research Laboratory mobile network ATD, location management and addressing, and supporting quality-of-service-based delivery. There was a great deal of interaction between speakers and attendees during and between sessions.

For more information, contact Scott Corson at corson@isr. umd.edu or (301) 405–6630.

What's inside

ISR
INSTITUTE FOR SYSTEMS RESEARCH

Three examples of ISR's continuing success in research growth

Already this year, ISR researchers have collaborated to win support for three major new research programs. These efforts exemplify ISR's successful research growth as it approaches emeritus status as an NSF Engineering Research Center.

As we mention in our cover story, researchers led by Professor Shihab Shamma (EE/ISR), Professor John Baras (EE/ISR), Professor P.S. Krishnaprasad (EE/ISR), Professor Steven Marcus (EE/ISR) and post-doc Didier Depireux have won a Multi-University Research Initiative (MURI-97) from the Office of Naval Research and are establishing a **Center for Auditory and Acoustic Research**.

ISR is a key participant in another MURI-97 award, this time from the Army Research Office. It is for research on the **Design and Control of Smart Structures**. The University of Maryland group is led by Professor P.S. Krishnaprasad (EE/ISR) and Professor John Baras (EE/ISR). Professor Roger Brockett (Harvard), another member of the ISR faculty, is also involved in this consortium.

In the last issue of *Systems Signals*, we told you about the third new research initiative in which ISR is playing a significant role in a large consortium. This is the Federal Aviation Administration's (FAA) new **Center of Excellence in Aviation Operations Research (NEXTOR)**. Professor Michael Ball (BMGT/ISR) heads the University of Maryland at College Park's team, which also includes Associate Professor Michael Fu (BMGT/ISR). It is anticipated that several other ISR faculty members will become involved in the center as projects develop.

Consortium members include the University of California at Berkeley, MIT and Virginia Polytechnic Institute. The consortium, joined by 18 companies which have committed $650,000 annually to the center, will address a broad spectrum of FAA needs in operations research, including air traffic management and control, human factors, system performance and assessment measures, safety data analysis, data collection/distribution, scheduling, workload management and distribution, navigation, communications and aviation economics.

The four universities will carry out a variety of research projects funded by the FAA, NASA and other agencies with interests in aviation. Additionally, the FAA can single-source complex research and development projects to teams drawn from the center's four universities and its industry partners.

These exciting new programs demonstrate the broad impact and diversity of applications for systems research as well as the effectiveness of ISR faculty in undertaking large, complex problems which require cross-disciplinary teams. Congratulations to the ISR researchers and their colleagues on these outstanding awards.

For more information on any of these research efforts, contact Jeff Coriale at coriale@isr.umd.edu or (301) 405–6604.

ISR wins two MURIs
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partnerships with collaborating teams in several DoD labs and industry). It will be working actively with industry leaders in the design, development and application of acoustic processors. The consortium begins work this May.

Design and Control of Smart Structures

ISR and the University of Maryland at College Park are an integral part of a three-university consortium just awarded a MURI on design and control of smart structures from the Army Research Office. Professor Roger Brockett (Harvard), Professor John Baras (EE/ISR) and Professor P.S. Krishnaprasad (EE/ISR) are ISR's researchers in the consortium.

Besides Maryland, the consortium includes Harvard University (the lead institution) and Boston University. The Maryland part of the project, managed through ISR, will perform research in modeling, simulation and control of magnetoelastic materials and other related problems of control of deformable bodies using electromagnetic fields; and computation and design tools for smart actuators and sensors. Maryland researchers will collaborate with other members of the consortium on fluid-structure interactions and design and fabrication of arrays of micro-actuators.

The award is $1 million per year for three years with the option of an additional two years. The consortium starts work in May and will be working actively with industry leaders in the design, development and application of smart materials.

ATIRP conference focuses on first year of research, future developments

This January, the Advanced Telecommunications/Information Distribution Research Program (ATIRP) consortium held its first annual conference at the University of Maryland at College Park's Inn and Conference Center. The two-day conference drew a large crowd of representatives from the Army, industry, and academia. It included four Army keynote speakers, paper and poster presentations, demonstrations,

and interaction between participants and speakers.

ISR is an integral part of the ATIRP federated laboratory consortium conducting basic research supporting the Army's digitization efforts. The federated lab concept is being pioneered by the Army Research Laboratory (ARL) as a way to cooperatively partner with industry and academia in conducting state-of-the-art research. The five technical factors in the ATIRP project are: wireless battlefield digital communications, tactical/strategic interoperability, information distribution, multimedia concepts and additional innovative research.

The consortium includes four industrial and five university partners. From industry: Sanders, a Lockheed Martin company; Bell Communications Research; Motorola, Inc.; and GTE Laboratories, Inc. In addition to the University of Maryland at College Park, the academic partners are the Massachusetts Institute of Technology; Howard University; the University of Delaware; and City College of New York.

Some 40 posters, representing ATIRP's first year research progress, were presented. Keynote speakers were Dr. A. Fenner Milton, Deputy Assistant Secretary for Research and Technology;

Brigadier General John S. Caldwell, Jr., Director of the Army Digitization Office; COL Roger W. Jones, Director of the TRADOC

ARL's Vito DeMonte

Program Integration Office, Army Battle Command System; and Robert F. Giordano, Director of CECOM Research, Development and Engineering Center. Opening and closing remarks were given by Vito DeMonte, the Deputy Director of ARL.

Discussion session topics included wireless battlefield digital communications, tactical/strategic interoperability, additional innovative research, information distribution and multimedia concepts research. A panel session focused on future Army technology needs in telecommunications and information distribution. It featured subject matter experts from HQDA, TRADOC, CECOM, and ARL.—*Libby Allen, ISR student assistant*

Five years of Young Scholars celebrated

ISR hosted a special luncheon on Saturday, March 15 for alumni of the Young Scholars program. University of Maryland President William E. Kirwan lauded the students, now either in college or their senior year of high school.

The program offers gifted students who have completed 11th grade the chance to spend the summer at the university and take the freshman engineering introductory course. More than 100 students have completed the program since its inception in 1991.

For more information, e-mail ISR's Mattie Riley at mattie@isr.umd.edu or call her at (301) 405-6608.

Industry news

Industrial affiliates recruit on campus

Two ISR industrial affiliates, Hughes Network Systems (HNS) and Northrop Grumman, came to the University of Maryland at College Park this spring to recruit for summer internship and permanent positions.

HNS held an open house on campus Feb. 24 to increase its visibility with students and recruit summer interns. HNS Human Resources Manager Bridgette Atkinson said the company hired over 100 student interns last summer.

The HNS-ISR relationship stems from work with ISR/CSHCN faculty, especially Professor John Baras, on projects such as DirecPC.

A strong history of hiring Maryland graduates has developed, said Jason Steinhorn, who was part of the HNS delegation. He earned his electrical engineering degree from the University of Maryland at College Park and is now an HNS engineer. While in college he had worked on joint projects with ISR.

Northrop Grumman came to campus March 18 "to help students learn more about our company," said Dave Coffey, a human resources manager.

Northrop Grumman representatives accepted resumes for summer and permanent positions, answered students' questions and gave a presentation on the corporation.

Kevin Kenny, a senior mechanical engineering major working with Associate Professor Guangming Zhang (ME/ISR) appreciated the fact that he got to talk with people performing jobs similar to those he could aspire to at Northrop Grumman. "Bringing along professionals close to us in age made it that much more relevant," he said.

ISR can work with your company to recruit students for summer and permanent positions. You can get a copy of our 1997 Student Resume Book by calling (301) 405-6632 or e-mailing us at isr@isr.umd.edu. Many of our students have online resumes at our web site: www.isr.umd.edu. To learn about making a corporate visit to ISR, contact Jeff Coriale at (301) 405-6604 or coriale@isr.umd.edu.
—Katherine Marks, ISR student assistant

CALCE-EPRC designing electronics for next-generation automobiles

Thirty researchers at the ISR-affiliated Computer Aided Life Cycle Engineering Electronic Packaging Research Center (CALCE EPRC) are assisting in designing and developing the next generation of cars. In cooperation with the Department of Energy's Office of Transportation Technology and the Partnership for a New Generation of Vehicles (PNGV), CALCE EPRC is investigating which materials would best suit the needs for electronic systems in the next generation of vehicles.

PNGV is a partnership between the U.S. government and the three U.S.-based automakers, aimed at strengthening competitiveness by developing technologies for a new generation of fuel-efficient vehicles. The PNGV program is structured around the goals of significantly upgrading U.S. manufacturing technology to reduce the cost and time to market for the next generation of vehicles, implementing commercially viable, innovative technologies for improved efficiency in current vehicle production, and developing a vehicle to achieve up to three times the fuel efficiency of today's six-passenger cars while maintaining market-driven attributes, including ownership cost.

Today, roughly 20 percent of a vehicle's cost is associated with electronic components, electrical controllers and sensors, and electrical machines. Reducing the cost and increasing performance of these electrical systems can have a significant impact on automotive performance efficiency and the cost of automobile ownership. Development of smaller, more thermally efficient power electronics will also affect overall vehicle performance by reducing demands on valuable non-passenger space.

Identifying electronic systems materials research efforts that are on the cutting edge of performance technology and also competitive in the marketplace is essential to completing the PNGV goals.

LAMP looks at semiconductor manufacturing

The new Laboratory for Advanced Materials Processing (LAMP) conducts research into semiconductor manufacturing processes. The lab features a $1 million ULVAC Japan ERA-1000 cluster tool and Leybold Inficon mass spectrometry equipment, both donated to ISR Director Gary Rubloff (MNE/ISR) by their manufacturers. The cluster tool, built for semiconductor manufacturing fabrication, is one of only a few such tools capable of processing the eight-inch silicon wafers that are today's standard in manufacturing.

LAMP is a collaborative facility associated with the Materials and Nuclear Engineering Department (MNE) and ISR, and organized by MNE Chairman Aristos Christou, Associate Professor Ramamoorthy Ramesh (MNE) and Rubloff. The research involves chemical engineering, electrical engineering and semiconductor process engineering. In addition to Rubloff, ISR faculty members involved include Professor P.S. Krishnaprasad (EE/ISR), Assistant Professor Raymond Adomaitis (ChE/ISR) and Associate Professor Evanghelos Zafiriou (ChE/ISR).

LAMP is managed by post-doc John Kidder, assisted by MNE graduate students Nayanee Gupta and Yiheng Xu.

The ISR researchers are interacting in this work with ULVAC Japan, Texas Instruments, Advanced Micro Devices, Motorola, CVC Products, Sematech and Leybold Inficon. LAMP's immediate goals are to develop processes for integrating advanced materials into new technology and to develop advanced material processes. The research will be ongoing, with a long-term goal of improving and enhancing manufacturing techniques for the semiconductor industry.

LAMP is developing mass spectrometry-based real time process monitoring that will enable semiconductor chip manufacturers to more closely monitor and better control the manufacturing process. Mass spectrometry allows the engineers to sort out gas molecules in the exhaust stream and compare what

LAMP manager John Kidder operates the ERA-1000, housed inside a Class 1,000 Clean Room. Inside the two chambers of the ULVAC tool, a chemical vapor deposition process deposits tungsten metal film layers onto wafers by flowing gases at high temperatures (400 degrees Centigrade). A single wafer, holding 50–250 chips, can be processed in each chamber.

is expected with what actually is happening. Existing models can be used for comparison, and new models can be built from what is observed.

In current semiconductor manufacturing, process controls are fairly primitive. "Right now the standard is to check the integrity of the finished wafer through measuring the thickness and other properties of the film layers," Kidder says.

The only way to tell whether a chip actually works as intended is to test it in an electronic device. By that time, many defective and useless chips already may have been produced.

But, Kidder says, by using mass spectrometry "deviations can be detected in real time, allowing the manufacturing process to be immediately halted or corrected if something has gone wrong."

"We hope that the results of our research will make semiconductor manufacturing less of a trial and error process," Kidder says. "Ultimately, we would like to be able to compensate for

deviations during the process through the use of controls. The machine should be able to sense when things are going wrong and adjust itself by altering processing conditions such as wafer temperature or gas flow."

Controls for such a system are being developed by the Krishnaprasad-Adomaitis-Zafiriou group.

ISR's unique environment—which brings together experts from many disciplines—makes it ideal for this kind of research. "While what I am doing in the LAMP lab ultimately relates to control issues, I am not that familiar with control theories," Kidder says. "On the other hand, process control experts may not understand much about semiconductor manufacturing. So we learn from each other through our collaboration."

A LAMP web page will soon be available on ISR's web site, www.isr.umd.edu. For more information, contact John Kidder at kidder@isr.umd.edu; (301) 405-0499.
—Libby Allen, ISR student assistant

Faculty news

New affiliated faculty members

Associate Professor Yu (Michael) Wang (ME) was selected as an ISR affiliate faculty member this spring. Wang's research activities focus on mechanical design, manufacturing, and dynamics and control. He specializes in developing techniques for designing and manufacturing automotive and aerospace space-frame structures. He has been working with ISR's Computer Integrated Manufacturing Laboratory in assembly modeling and planning, design and fabrication process connections, and integrating structural optimization with active control.

Assistant Professor Carol Smidts (MNE) was selected for ISR affiliate faculty membership late last summer. Along with MNE's Ali Mosleh, she was recently awarded $275,000 by NASA to develop a methodology and integrated software platform to perform generic and mission-specific risk analysis for the Space Shuttle. Among her research interests are dynamic accident modeling, simulation and dynamic probabilistic assessment, control room operator reliability (cognitive) modeling, methodology for security risk management for computer systems and space systems risk assessments.

Achievements

This spring **Professor Thomas McAvoy** (ChE/ISR) was selected as a 1997-98 Distinguished Scholar-Teacher by the University of Maryland. The honor includes public presentations, activities for the university and funds to support his professional activities.

Associate Professor Adrian Papamarcou (EE) was presented with the 1996 E. Robert Kent Outstanding Teaching Award by the University of Maryland's Clark School of Engineering in December.

The Control Handbook, edited by **Professor William S. Levine** (EE), took first place in the Association of American Publishers' annual awards contest as the "Best Engineering Handbook of 1996." Levine also has been named as the editor of a new Birkhäuser series of publications on mathematical aspects of control, *Systems and Control: Foundations and Applications.* The series includes advanced textbooks, graduate textbooks, case studies and monographs.

Associate Professor Michael Fu's (BMGT/ISR) research monograph, *Conditional Monte Carlo: Gradient Estimation and Optimization Applications,* was published by Kluwer Academic Publishers in March. Jian-Quiang Hu was co-author. *Information is available from the publisher at http://kapis.www. wkap.nl/kapis/CGIBIN/WORBD/book.htm?0-79239873-4.*

In August, **Associate Professor Christos Faloutsos** (CS/ISR), along with Yossi Matias and Abraham Silberschatz, filed for a patent for their work with Lucent on a method for characterizing information in data sets using multifractals. The patent is pending.

Faloutsos and **Professor Nicholas Roussopoulos** (CS), along with Timos Sellis, were awarded the 1997 VLDB 10 Year Paper Award for their work, *The R+-Tree: A Dynamic Index for Multi-Dimensional Objects,* VLDB 1987, pp. 507-518.

Associate Professor Thomas Fuja (EE/ISR) is spending 1997 in a visiting position as Program Director for Communications Research at the National Science Foundation. He is overseeing the allocation of NSF's $5 million annual support of physical-layer communication research in areas such as data compression, modulation, equalization, multiple access and coding.

Professor Ben Kedem (Math) received the Goddard Exceptional Achievement Award this spring for outstanding contributions related to his Tropical Rainfall Measuring Mission project.

Professor Michael G. Pecht (ME/ISR), director of the Computer Aided Life Cycle Engineering Electronic Packaging Research Center, and N.D. Stojadinovic of the University of Nis, Yugoslavia, have been appointed Editors-in Chief of *Microelectronics and Reliability* by Elsevier Science. The journal's aims and scope are dedicated to disseminating research results and related information on the reliability of microelectronic devices, circuits and systems.

Congratulations to **Leandros Tassi-**

The ISR-affiliated Center for Satellite and Hybrid Communication Networks held its semi-annual Industrial Advisory Board meeting February 19. The meetings provide CSHCN industry partners with a forum to guide research and provide feedback. At left, CSHCN Director John Baras. At right, IAB members and CSHCN faculty.

ulas (EE/ISR,) who has been promoted to Associate Professor, effective July 1, 1997.

Associate Professor James Hendler (CS/ISR) has been interviewed by the media several times recently. In May, the Australian Broadcasting Co. talked to him about the Kasparov vs. Deep Blue chess match; in February, Nickelodeon News did an interview with film footage on autonomous robots; and last December, Christian Science Monitor Radio talked to Hendler about the "birthday" of HAL, the computer gone bad in *2001: A Space Odyssey.*

Dr. Judith Dayhoff, an ISR Assistant Research Scientist, is now president of the International Neural Network Society. Dayhoff has been on its board for six years, and was vice president in 1991. She also was a research associate in the AFOSR Faculty Research Program last summer, and has just received an AFOSR Summer Research Extension Award, "Dynamic Neural Networks: Towards Control of Optical Air Flow Distortions."

Visitors

Zvi Boger, chief R&D engineer, Division of Operation Nuclear Research Center in Negev, Israel, is visiting ISR and conducting research with **Professor Thomas McAvoy** (ChE/ISR) on the artificial nose project. During his visit, he is also doing research at NIST.

David Chancogne, *(see inset box at right),* a graduate student in electrical engineering at INSA, Toulouse, France, has been visiting for 16 months. He is working with **Associate Professor Mark Austin** (CE/ISR) and **Professor John Baras** (EE/ISR) on the applications component of the International World Wide Web project.

Dr. Su-Shing Chen, professor of computer science at the University of North Carolina at Charlotte and program director of the Information Technology and Organizations Program and Digital Libraries Project at NSF, is continuing his visit. He is working with **Professor Dana Nau** (CS/ISR), **Associate Professor James Hendler** (CS/ISR), **and Associate Professor V.S. Subrahmanian** (CS/ISR) on discrete event

systems and computer science with applications in manufacturing systems.

Dr. David Elliott, Professor Emeritus of Mathematical Systems at Washington University, St. Louis, continues as a visiting senior research scientist, conducting research on bilinear systems and interacting with students. Elliott co-edited (with Omid Omidvar) the new book *Neural Systems for Control,* published in January by Academic Press in Boston. **Professor Shihab Shamma** (EE/ISR) co-wrote the "Neurocontrol in Sequence Recognition" chapter with W.J. Byrne. *Information on the book can be found on the Internet at http://www. apcatalog.com/cgibin/AP?ISBN= 0125264305& LOCATION=US&FOR M=FORM2*

Dr. Der-Cherng Liaw, Associate Professor of Control Engineering and Director of the Institute of Control Engineering at National Chiao Tung University, Taiwan, concluded his year-long visit in February. He worked with **Professor Eyad Abed** (EE/ISR) on modeling, stability and bifurcation analysis, control of distributed power systems and related nonlinear control issues.

Dr. Sea-Hyson Nam, Professor, Department of Computer and Communication Engineering, Taegu University, Korea, is visiting through mid-July. He is working with **Professor Anthony Ephremides** (EE/ISR) in wireless and hybrid communication networks.

Vincent Schachter, a Ph.D. student in information theory at l'Ecole Normale Superieure in France, is visiting until January 1998. He is working with **Professor John**

Baras (EE/ISR) on constraint-based reasoning and constraint-based programming theory and applications.

Chin-Jiun Su, a Ph.D. student at Polytechnic University Brooklyn, N.Y., is conducting research with **Assistant Professor Leandros Tassiulas** (EE/ISR) on wireless communications.

Dr. Van P. Thompson, Director of Dental Materials and Professor of General Dentistry at the Baltimore College of Dental Surgery at UMAB, is visiting until November. He is conducting research on processing new dental materials with **Associate Professor Guangming Zhang** (ME/ISR).

Other news

The University of Maryland at College Park's A. James Clark School of Engineering jumped 10 places to 18th in the nation in *U.S. News and World Report's* 1997 rankings of engineering graduate schools and programs. It was the most dramatic increase of any engineering school in the United States.

ISR visitor's award-winning web site

An Internet tour of French culture designed by David Chancogne, a French graduate student visiting ISR, recently won the Golden Web Award for best cultural web server and the "top 5 percent" Magellan award.

Chancogne developed the site for the French Embassy in Canada. It was the first French government web server.

The site points to information on study in France, French language courses, performing and fine arts, music, film, museums, current news, cultural reviews, children's books, poetry, essays, foreign affairs, food and tours. The user can choose to have text appear in either French or English.

Chancogne worked on the web server with two other people as part of his required internship for graduation from INSA, the Institute of National Applied Science in France. Chancogne's job was to convert all the text into HTML.

At ISR, Chancogne works on HTML, Java, and CGI programming. Last semester he helped teach a class in Java. He will continue at ISR for the near future, working with Associate Professor Mark Austin (CE/ISR) and Professor Shihab Shamma (EE/ISR).

The URL for the French Cultural Explorer web site is http:// ottawa.ambafrance.org/index_eng.html.
—Katherine Marks, ISR Student Assistant

We're improving our service to you

New look for ISR web site

ISR's web site, www.isr.umd.edu, has just been updated with a new look that makes it easier to find what you're looking for. If you haven't visited the site for a while, check it out and *let us know what you think*. New features include:

- Online student resumes

- Direct links to publishers for books by ISR faculty members

- Enhanced search features for ISR Technical Reports

- Adobe Acrobat PDF versions of many of our publications, including our annual report and *Systems Signals* newsletter.

- Complete travel information for ISR visitors, including driving directions, where to stay and eat, a campus map and parking information.

More new features are on the way, so stop by often!

Mailing list update

We are in the midst of updating our mailing list database to serve you better. But we need your help!

- Please take a moment to check your mailing label for correctness.

- If you'd like to learn about ISR developments via e-mail, send your e-mail address to us at *isr@isr.umd.edu.*

- If you know people who might like to receive this publication, pass their names along to us and we will add them to our database.

- If you are no longer interested in receiving *Systems Signals*, we will remove your name from our files.

E-mail your address corrections, additions and deletions to us at isr@isr.umd.edu, or send them via regular mail to Tina Wong, ISR, A.V. Williams Building, University of Maryland, College Park, MD 20742. Thank you!

Student Resume Books and Poster Books available

Each year ISR prepares a book of our students' resumes for companies seeking summer interns and applicants for permanent positions. We also prepare a poster book highlighting the year's research.

Both books are indexed by subject and key word so that you can quickly find the area that interests you.

If you would like a copies, a limited quantity of each book is still available.

Just e-mail us at isr@isr.umd.edu or call us at (301) 405-6632, and we will take care of the rest.

ISR robots stroll through the Smithsonian's Air and Space Museum. Assistant Professor Gregory Walsh (ME), shows a young girl how to give commands to a walking robot. Dr. Walsh, his students and the robots were a hit at the National Engineering Week program for youth, Feb. 19.