



SYSTEM SOLUTIONS

THE INSTITUTE FOR SYSTEMS RESEARCH

The
Institute for
Systems
Research

INSIDE

- 2 Director's Corner
- 3 Shneiderman-Hendler Debate
- 4 Major Awards
- 5 Industry News
- 5 Espy-Wilson New NIH Study Section Member
- 5 Block Grant for MSSE Program
- 5 Levine named AACC Vice President
- 6 Faculty, Student, Staff and Alumni News
- 7 Wide Focus
- 8 Media Coverage

Gupta wins PECASE; Barua, Ghodssi and Wu win NSF CAREER awards

Four ISR faculty members have been selected to receive prestigious early career awards.

Assistant Professor **S.K. Gupta** (ME/ISR) has won a Presidential Early Career Award for Scientists and Engineers (PECASE) for his work on developing a new molding process and decision support tool that make it possible to manufacture multi-material parts in a cost-effective manner. This research allows designers to select different materials for different portions of the part, creating new product possibilities that never existed before. Some examples are high-performance, low-weight noise control structures, snap fits with superior fatigue-life, and hermitically-sealed sensor housings

The PECASE is the highest honor given by the U.S. government to outstanding scientists and engineers in the early stages of establishing their research careers. Only 20 NSF-supported PECASE awards are given out each year.

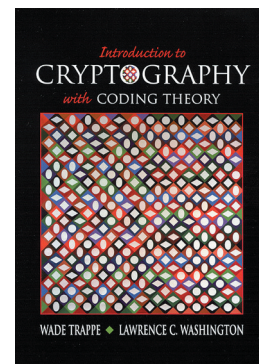
Assistant Professor **Rajeev Barua** (ECE/ISR) has received an NSF Faculty Early Career Development (CAREER) Award for "Synthesis-Assistance and Compilation Software for Embedded Systems." He will develop new technologies to help synthesize embedded application-specific processors.

Assistant Professor **Reza Ghodssi** (ECE/ISR) received a CAREER Award for "InP-Based MEMS for Optical Microsystems."

ISR-affiliated Assistant Professor **Min Wu** (ECE/UMIACS) received a CAREER Award for "Signal Processing Approaches for Multimedia Security and Information Protection."

The five-year awards began Feb. 1, 2002. CAREER awards support promising college and university junior faculty who are committed to the integration of research and education. [ES](#)

ISR doctoral student co-authors undergrad cryptography book



ISR doctoral student **Wade Trappe** and Math Department Professor **Lawrence C. Washington** are the authors of a new Prentice Hall textbook, *Introduction to Cryptography with Coding Theory*. The book grew out of a

cryptography class the two developed at the University of Maryland.

Trappe is an Applied Math and Scientific

continued on page 2

Director's Corner



On behalf of the faculty, staff and students of the Institute for Systems Research, welcome to this issue of *System Solutions*. ISR continues to be a unique and exciting place for research and education at the frontiers of cross-disciplinary systems science and engineering. Some aspects of the richness of the ISR's programs and activities are reflected in the articles in this issue, which I hope you will enjoy.

At the beginning of the fall semester, after a successful five-year term as director, my friend and colleague Gary Rubloff returned to regular academic life to pursue his research and teaching goals full time. I accepted to serve as Acting Director at the time, and have been enjoying my increased interactions with faculty, staff and students and with our friends within and outside the university. I know that I speak for the whole ISR community in expressing sincere thanks to Gary for his dedication and service to the ISR, which are continuing in other forms since his rejoining the ranks of the regular faculty. A search committee has begun its activities to recruit the next Director of ISR.


We are now seeing the impact of last year's successful recruiting season. Since the last issue of this newsletter, we have been very pleased to welcome a group of outstanding new faculty:

Carol Espy-Wilson (Associate Professor, joint with Electrical and Computer Engineering); **Richard La** (Assistant Professor, joint with Electrical and Computer Engineering); **Sennur Ulukus** (Assistant Professor, joint with Electrical and Computer Engineering); **Pamela Abshire** (Assistant Professor, joint with Electrical and Computer Engineering); and **Ralph Etienne-Cummings** (Associate Professor, Joint with Electrical and Computer Engineering).

We also welcomed three new affiliate faculty members: **Robert Dooling** (Professor, Psychology); **Min Wu** (Assistant Professor, Electrical and Computer Engineering/Institute for Advanced Computer Studies); and **Jonathan Simon** (Assistant Professor, Electrical and Computer Engineering). **Michael Gruninger** and **Eric Justh** joined ISR as Assistant Research Scientists.

In addition, **Cynthia Moss** (Professor, Psychology) moved from being an affiliate faculty member to holding a Joint Appointment with ISR, and **Mark Fleischer** moved from Research Associate to the faculty rank of Assistant Research Scientist, working mainly in the Center for Satellite and Hybrid Communication Networks (CSHCN).

Our relationships with our corporate partners are progressing well. We have continued and strengthened old alliances, and are forging new mutually beneficial relationships with several companies. We are grateful to all of our industrial and government partners for their participation in and contributions to our research and education programs.

In the fall semester, we held a two-part faculty and staff retreat, in which many important issues were discussed. In the next *System Solutions*, I hope to report to you on the implementation of some of the ideas generated in the retreat. 

New cryptography book

continued from page 1...

Computing major affiliated with both ISR and the Electrical and Computer Engineering Department. He expects to complete his doctoral research on security architectures for multicast in 2002. His advisor is Professor **K.J. Ray Liu** (ECE/ISR).

When Trappe arrived at the university in fall 1996, he looked forward to learning more about cryptography, a subject in which he'd become interested during his undergraduate days at the University of Texas. With the National Security Agency just up the road, Trappe figured the University of Maryland would be prime cryptography country.

To his surprise, Trappe learned Maryland didn't offer the subject. Undaunted, he got together with Larry Washington, a number theory specialist who encouraged him to learn more about the field through independent study.

The two then developed an undergraduate class in the subject for spring 1998. They eventually settled on a format that utilized both a classroom and computer theater environment where students could experiment with examples and problems. The class has filled its enrollment limit each time it has been offered, and now satisfies core requirements in the Computer Science Department.

In their search for a text for their class, they found no up-to-date texts that were suitable for upper division courses.

So, Trappe says, "We started writing up notes to explain the concepts in the text, and found people liked the class more as a result."

By the time the class was offered in Spring 1999, printed copies of the notes were made available. "The students told us at the end of the semester that they really enjoyed the course notes. They liked our writing style," Trappe says.

Washington and Trappe realized they were on to something. Over the years the two built up their notes and added Mathematica code. The eventual textbook grew from there.

“The book is a compilation of everything we’ve tried that has worked,” Trappe says. “We made it an enjoyable read – for example, we include historical examples from World War II to convey fundamental ideas and we threw in a cryptography example from the Sherlock Holmes story, ‘The Adventure of the Dancing Men.’”

Washington and Trappe also have included current cryptography examples such as e-commerce and visual cash, as well as glimpses of the near future with sections on the emerging disciplines of elliptic curve and quantum cryptography.

The text contains three extensive appendices of computer problems and examples, in Mathematica, Maple, and MATLAB. Many chapters have computer problems. Functions and code are downloadable at the Prentice-Hall web site.

Chapters include: Classical Cryptosystems; Basic Number Theory; The Data Encryption Standard; AES: Rijndael; The RSA Algorithm; Discrete Logarithms; Digital Signatures; E-Commerce and Digital Cash; Secret Sharing Schemes; Games; Zero Knowledge Techniques; Key Establishment Protocols; Information Theory; Elliptic Curves; Error Correcting Codes and Quantum Cryptography.

For more information, visit Prentice Hall’s web site at <http://vig.prenhall.com/catalog/academic/product/1,4096,0130618144,00.html>. ☞

ISR’s Hendler and Shneiderman debate the Internet’s future at ASIS



Ben Shneiderman and James Hendler

Professors Ben Shneiderman (CS/ISR) and James Hendler (CS/ISR) fired up the PowerPoint and engaged each other on the future of the web at the American Society for Information Science and Technology’s 2001 Annual Meeting, November 8 in Washington, DC.

The colleagues hold strong, differing views about guiding principles for design of future technologies.

Hendler envisions a semantic web for enhancing human communication. He believes agents that traverse the web and multiple ontologies that describe information can provide breakthrough technologies for web applications.

Shneiderman emphasizes the social nature of knowledge sharing based on dialog, empathy, responsibility and trust. He promotes comprehensible and universal interface designs that are consistent, predictable and controllable.

During their debate, Hendler said better user interfaces wouldn’t solve every problem on the web. “Today interfaces are expensive and take six months to a year to build,” he said. “Everyone should be able to build an interface.”

Championing the need for web agents that search for items specific to the individual user, Hendler said, “I don’t want to do everything through menus because they can’t predict everything I might want to do.”

Hendler proposed web organization like the Dewey Decimal System found in libraries. “The web we have today won’t get any better for single document and keyword search. There are no organizing principles. We need some way to organize it.”

Shneiderman said agents were fine, “if they are under the table crawling through the web.” Making them visible to the user is “the big mistake. People need to feel that they are in control. We are not like machines. Machines should not mimic people.”

“I don’t want our choices to be taken away from us, for people to be taken out of the equation,” Shneiderman said. “Agents can go bad — a virus is an agent. If they are made autonomous, they cannot be stopped. When humans are taken out of the equation, there is danger. Who would be responsible for what the agent does?”

Hendler responded, “That doesn’t mean agents shouldn’t be built. We just need to be careful how they are built.”


Shneiderman advocated more emphasis on empirical testing and studies for human computer interface, something he said is often given short shrift as new web technologies are being built. Hendler countered that would stifle progress on the web. “You have to build something first,” he said. “God help us if in this country we stop building things and just start conducting empirical studies.”

The two also noted the similarities in their positions. “The artifacts that come out of our different approaches are often similar,” Hendler said. “We need to figure out how to let the web happen, and yet keep it under control.” ☞

Narayan awarded NSF grant for secret key generation

Professor **Prakash Narayan** (ECE/ISR) is the principal investigator for a \$371,049 National Science Foundation award, "An Information Theoretic Approach to Secret Key Generation for Encrypted Communication in a Network."

His project addresses information security, an issue of critical importance in communication networks. It will undertake a novel approach for achieving integrity, authentication and privacy among the nodes of a network. The principal challenge concerns the generation and establishment of secret keys in such a network for secure encrypted communication among the nodes. The approach is based on information theory and will provide new insights into the problem of secret key generation. It also holds promise for developing novel techniques and algorithms in cryptosystem design.

Dr. Narayan's award is part of NSF's Information Technology Research program. The program's main goals are to augment the nation's IT knowledge base and strengthen the IT workforce. According to NSF, the awards are "designed to preserve America's position as the world leader of computer science and its applications." 


Schmidt leads new RISE program

Associate Professor **Linda C. Schmidt** (ME/ISR), Anne M. Spence (acting director of Women in Engineering at the A. James Clark School of Engineering) and Dr. Janet Schmidt have been awarded

a \$900,000 grant by the National Science Foundation's Program for Gender Equity (PGE) in Science, Mathematics, Engineering and Technology (SMET).

Schmidt is the principal investigator of the three-year Research Internships in Science and Engineering (RISE) program, designed to encourage the participation and persistence of women students in engineering and the sciences. The first RISE student class will arrive on campus in summer 2002. Support for female faculty mentors is a core feature of RISE.

The research teams will be trained in SMET research fundamentals, mentoring partnerships, team functioning, and psychological constructs key to enhancing the successful learning of women students.


"It is our hope that this program will be the foundation for increased recruitment and retention of female students at both the undergraduate and graduate levels in engineering," said Clark School Dean **Nariman Farvardin** (ECE/ISR). 

Davis, Makowski, Milner get optical wireless network contracts

Professor **Christopher Davis** (ECE/ISR), Professor **Armand Makowski** (ECE/ISR) and ISR Senior Research Scientist **Stuart Milner** have been awarded a contract for Omni-Directional Optical Wireless Networks by the U.S. Army Communications and Electronics Command.

They will design, prototype, and field test a unique prototype optical 3-dimensional communication node and demonstrate its utility as part of a diverse wireless network, which can provide assured and


robust communications between sensors over short ranges by diffuse reflection - (e.g., in areas of dense vegetation.) In addition, a specification of a network service model and protocols for control of topology, link management, service discovery, transport and interoperability with other communication protocols will be provided.

In addition, Davis and Milner have been awarded a contract for Three Dimensional Optical Wireless Networks by the Army Research Laboratory. They will design, develop and prototype a unique three-dimensional optical communication node and demonstrate its utility as part of a diverse, reconfigurable wireless network. 

Ghodssi, DeVoe awarded MRI for MEMS aligner/bonder

ISR researchers are part of a University of Maryland team that won a \$239,405 NSF Major Research Instrumentation Award (MRI) to purchase an aligner/bonder for MEMS and Microsystems research.

Assistant Professor **Reza Ghodssi** (ECE/ISR) is the principal investigator; co-PIs are: Assistant Professor **Don DeVoe** (ME/ISR), Assistant Professor **Elisabeth Smela** (ME) and Professor **John Melngailis** (ECE/IREAP).

The state-of-the-art microfabrication equipment patterns features in photosensitive polymeric materials, aligns multi-stack silicon wafers, and other materials like glass, with micron scale accuracy and bonds these wafers permanently to form structures and devices of different shapes and forms. 

Espy-Wilson new NIH study section member

Associate Professor **Carol Espy-Wilson** (ECE/ISR) has accepted an invitation from the National Institutes of Health to serve as a member of the Biobehavioral and Behavioral Processes (3) Study Section, (BBP) Center for Scientific Review.

This membership will allow Dr. Espy-Wilson to contribute to the national biomedical research effort.

Study sections review and make recommendations on grant applications submitted to NIH and survey the status of research in their fields. The BBP covers language and other types of communication and their development across the lifespan [infancy through old age]. It encompasses all forms of language and communication, both normal and disordered. Also included is the development and evaluation of preventive and therapeutic interventions for language and communication disorders.

Members are selected on the basis of their demonstrated competence and achievement in their scientific discipline as evidenced by the quality of research accomplishments, publications in scientific journals, and other significant scientific activities, achievements and honors. [ES](#)

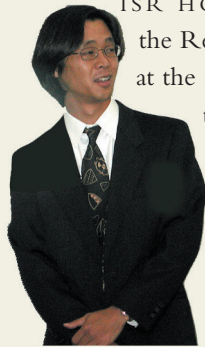
Block grant for MSSE program

ISR has been given a \$16,000 block grant fellowship award from the University of Maryland graduate school. The grant will allow ISR to recruit an outstanding MSSE student for 2002 early in the recruitment season. **Lee Harper**, Coordinator of Educational Programs, prepared the winning proposal. [ES](#)

Levine named AACC VP

ISR-affiliated Professor **William Levine** (ECE) has been named Vice President of the American Automatic Control Council (AACC) for 2002-2003. The vice president normally becomes the president for the two years after his or her term as vice president. [ES](#)

industryNEWS



ISR HONORED MR. EIJI ADACHI, engineer in the Research Department of Honda R&D Inc., Japan, at the end of his 14-month visit with ISR. At the event, Mr. Adachi also presented a seminar on “Dynamics and Stability of Motorcycles.” While here, he conducted research with Dr. Balakumar Balachandran on the dynamic analysis of a motorcycle structure via modeling and simulation.

NORTHROP GRUMMAN'S DIRECTOR OF INDUSTRY-UNIVERSITY INITIATIVES GEORGE REYNOLDS PRESENTED A \$50,000 CHECK to Clark School Dean **Nariman Farvardin**. A portion of this funding helps to support the ISR/Northrop Grumman Fellowships.

From left to right, ISR Director **Gary Rubloff**; fellowship recipient Sara Hewitt; Dean Farvardin; George Reynolds; fellowship recipient Sean Gahagan; ISR Assistant Director for External Affairs **Jeff Coriale**; and Associate Professor **Jeffrey Herrmann** (ME/ISR), advisor to the fellows.



ISR WELCOMED MR. YOSHIO IKEDA, MR. SHU YAMADA, AND MR. MASAHIRO KOTAKE from ISR Industrial Partner Toshiba Corporation for a three-day visit, Jan. 23-25. [ES](#)

faculty, student, alumni and staff NEWS

Fellows

Professor **Cynthia Moss** (Psychology/ISR) has been elected a Fellow of the Acoustical Society of America. Moss also recently received a \$340,000 NSF award for "Active Sensing for Three-Dimensional Auditory Localization." In addition, Moss and Catherine Carr (Biology) received an NIMH training grant for "Neuroethology: Neurobiology, Evolution and Behavior."

ISR-affiliated Professor **Joseph Jájá** (ECE) has been named a Fellow of the Association for Computing Machinery (ACM) for his contributions to the design and analysis of parallel algorithms, algebraic and combinatorial complexity, VLSI architectures, and high-performance computing. He is the director of the Institute for Advanced Computer Studies.

New faculty

ISR welcomed five faculty jointly appointed with the Electrical and Computer Engineering Department: Associate Professors **Carol Espy-Wilson** and **Ralph Etienne-Cummings** and Assistant Professors **Pamela Abshire**, **Richard La** and **Sennur Ulukus**.

We also welcomed three affiliate faculty: Professor **Robert Dooling** (Psychology), Assistant Professor **Jonathan Simon** (ECE), and Assistant Professor **Min Wu** (ECE/UMIACS).

In addition, there are three new assistant research scientists: **Mark Fleischer**, **Michael Gruninger** and **Eric Justh**.

UMD awards

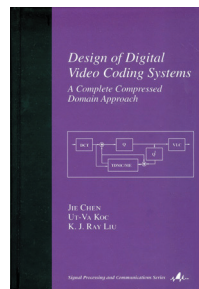
ISR-affiliated Professor **Ramamoorthy Ramesh** (MNE) received the Faculty Outstanding Research Award from the A. James Clark School of Engineering for his contributions to the science and technology of materials, especially his landmark contributions to ferroelectrics. The award

recognizes exceptional and influential engineering research.

CSHCN Coordinator **Diane Hicks** received a University of Maryland Exceptional Performance Award in recognition of her outstanding accomplishments and contributions to CSHCN and the greater university community.

Congressional testimony

Professor **Ben Shneiderman** (CS/ISR) testified before the House Governmental Affairs Subcommittee on Government Efficiency, Financial Management and Intergovernmental Relations on the issue of a national identification system. His testimony is available on C-SPAN at www.c-span.org/terrorism/security.asp. Select "November 2001," and choose "Hearing on a National Identification System."



Coding Systems: A Complete Compressed Domain Approach. The book is published by Marcel Dekker, Inc.

Patents

Professor **Anthony Ephremides** (ECE/ISR), **Deepak Ayyagari** (ISR); and **Samuel Resheff** (Verizon Laboratories) have been awarded U.S. Patent 6,278,701 for "Capacity enhancement for multi-code CDMA with integrated services through quality of services and admission control."

ISR-affiliated Assistant Professor **Min Wu** (ECE/UMIACS) is the holder of two U.S. patents: 6,282,300, "Rotation, scale,

and translation resilient public watermarking for images using a log-polar fourier transform" and 6,285,775, "Watermarking scheme for image authentication."

An updated list of ISR patents is at www.isr.umd.edu/ISR/research/patents.html.

ISR awards

S.K. Gupta received the Outstanding Faculty Award. Gupta conducts research in process planning for small-batch manufacturing, web-based manufacturability analysis services and a new multi-stage, multi-piece molding process to create geometrically complex heterogeneous objects. He was recently ranked as one of the University's top 100 rainmakers, quite an accomplishment for an assistant professor. He has been proactive in securing research funding, has acquired much-needed equipment for the CIM lab through two NSF grants, and is playing a key role in developing strategic partnerships between ISR, government and industry.

Vasilios Lagakos, an MSSE student specializing in communication and networking systems, received the George Harhalakis Outstanding Systems Engineering Graduate Student Award. A paper he wrote with Civil Engineering PhD student Evangelos Kaiser was accepted for inclusion in the INCOSE 2001 Symposium program. The paper described a systems engineering profile for marine navigation systems in narrow channels, including a discrete event simulation model for narrow passageways such as the Panama Canal, one-way bridges and highway construction zones. This is the first time INCOSE has accepted an MSSE student's paper for publication.

Coordinator **Karen Deal** received the Outstanding Staff Award. She was honored for her commitment to the best interests of ISR; her innovative ideas; her thoroughness

and attention to detail, and her dedication to working with faculty, staff, industrial partners and students.

Alumni news

Matthew James has been elected an IEEE Fellow. He is Reader and Acting Head of Engineering in the Department of Engineering at the Australian National University, Canberra. Matt finished his PhD in Applied Mathematics in ISR under Professor John S. Baras' (ECE/ISR) direction in 1988. Dr. Baras notes that Matt "achieved this important recognition in record time" and was an ISR Fellow throughout his three years here.

Nick Sidiropoulos received a 2001 Best Paper Award from the IEEE Signal Processing Society. "Parallel Factor Analysis in Sensor Array Processing" was published in the *IEEE Trans. on Signal Processing*. Sidiropoulos, a student of Professor John S. Baras (ECE/ISR) and assistant research scientist here, was an ECE Ph.D. and is an associate professor in the Electrical and Computer Engineering Department at the University of Minnesota.

ISR alumnus **Charles S. Falkenberg** (45) died with his wife Leslie Whittington and two daughters Zoe and Dana aboard American Airlines Flight 77 when it hit the Pentagon on September 11, 2001. The family was en route to Australia where Whittington, a Georgetown University professor, had been awarded a short-term visiting fellowship. In the mid-1990s, Falkenberg earned both a B.S. and an M.S. in Computer Science at the University of Maryland. He worked with Professor **Carlos Berenstein** (Math/ISR) on managing data related to the Alaskan Exxon Valdez disaster. At the time of his death Falkenberg was lead software engineer for ECOlogic Corp. in Lanham, Md. and was working on a project for NASA. ☞

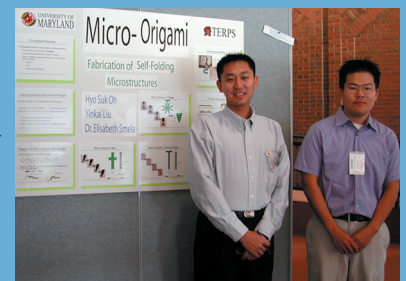


NSF DIRECTOR **RITA COLWELL** (L) WAS THE KEYNOTE SPEAKER AT THE UNIVERSITY OF MARYLAND'S BIOSCIENCE RESEARCH & TECHNOLOGY REVIEW DAY, Nov. 13 in College Park. Dr. Colwell spoke of the many synergistic advantages of industry, academic, and government partnerships, and said NSF Engineering Research Centers such as ISR are "an incredible success story" that "set an international example for collaboration."

In addition, Professor **Shihab Shamma** (ECE/ISR), center, was part of a panel on "Building Partnerships in Neuroscience." The session was moderated by ISR affiliated Professor **Robert Dooling** (Psychology), at right.



ASSISTANT PROFESSOR **REZA GHODSSI** (ECE/ISR) HELPED ORGANIZE the MEMS Alliance's Special Topics Symposium on MEMS Technologies in Microfluidics and RF Applications, Nov. 16 at the Johns Hopkins Applied Physics Laboratory in Laurel, Md. The University of Maryland team (right)



of **Hyo Suk Oh** and **Yingkai Liu**, advised by Dr. Elisabeth Smela, ME, took second place in the independently refereed poster session for their work on "micro-origami" — the fabrication of self-folding microstructures.



THE NEW COLLABORATIVE TECHNOLOGY ALLIANCE IN POWER AND ENERGY held its initial Consortium Management Committee Meeting. The University of Maryland welcomed close to 50 participants. The Army Research Laboratory award is shared by a consortium of seven industry and 16 academic participants. Clark School Dean **Nariman Farvardin** welcomed the group to the university. Assistant Professor **Reza Ghodssi** (ECE/ISR), the principle investigator for the Maryland participants, hosted the meeting. ☞

mediaCOVERAGE

A PAPER ON COMPLEXITY THEORY co-authored by ISR Assistant Research Scientist **Michael Hadjitheodosiou** has received main-stream press attention in Great Britain. This mathematical method is used to predict the behavior of highly complex systems has application to Britain's National Health Service. The story was picked up on BBC Radio 4, *BBC News Online* and the *London Daily Mail*. The work originally was published in the *Journal of the Royal Society of Medicine*.

THE OCT. 28 *BALTIMORE SUN* quoted Professor **Michael Fu** (Business/ISR) in its article about the dollar-cost averaging technique for investing in the stock market.

THIS FALL, MARYLAND PUBLIC TELEVISION'S *Direct Connection* program featured Assistant Professor **Allison Druin** (EDU/UMIACS/ISR). Druin talked about her research on technology and the early childhood education classroom environment. Druin also was quoted in a *San Francisco Chronicle* holiday story about children's toy technology.

THE ITALIAN NEWSPAPER *Alto Adige* interviewed Professor **Gary Rubloff** (MNE/ISR) about his work in protein technology and chips at IRST in Trento.

DURING HIS RECENT TRIP TO AUSTRALIA, the *Australasian Business Intelligence Service* described Professor **Thomas McAvoy** (ChE/ISR) as "a world authority on dynamic modeling, which can be used efficiently in controlling chemical and petroleum plants."

THE *BALTIMORE SUN* spoke to Professor **Ben Shneiderman** (CS/ISR) Oct. 25 in its article about Microsoft's new "Windows XP" operating system. He said the product will exacerbate the "digital divide" between rich and poor because it requires features of fairly new computers to run.

MIT AND IEEE have recently featured Professor **James Hendler** (CS/ISR) in stories about the semantic web. His work with DARPA was mentioned in a recent *MIT Technology Review* article, and Hendler wrote an article on "Agents and the Semantic Web" for *IEEE Intelligent Systems*. ☺

ISR Industrial Affiliates

Sustaining Partner

Northrop Grumman Corporation

Partners

GE Corporate R&D
Toshiba Corporation

Participants

America Online
Boeing Commercial Airplanes
Boeing Communications
E.I. du Pont de Nemours Co.
Honda Research and Development
Honeywell, Inc.
Hughes Network Systems
INFICON, Inc.
Intelligent Automation, Inc.
Lockheed Martin Global Telecommunications
Rational Software Corp.
Telcordia Technologies
TogetherSoft Corp.

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

2169 A.V. Williams Building, University of Maryland, College Park, MD, 20742

Phone: 301.405.6615 **Fax:** 301.314.9920

Web site: www.isr.umd.edu

Editor: Rebecca Copeland



A. JAMES CLARK
SCHOOL OF ENGINEERING

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

Nonprofit Org.
U.S. Postage
PAID
Permit No. 10
College Park, MD