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## Director's Message

# Congratulations to Prof. Holman & Prof. Scholtz

I begin by congratulating two senior faculty members, Prof. Tom Holman and Prof. Bob Scholtz, for receiving major awards. Prof. Holman, a Professor of Film Sound in the School of Cinema-Television, has won a 2001 Academy Award for technical achievement for the improvement of cinema audio over a considerable period of time. Prof. Holman has been a key IMSC investigator from the start, and his research in IMSC's Immersive Audio lab includes work on 10.2 channel sound. (See page 1.)



**Dr. Ulrich Neumann**

Dr. Scholtz, a Professor of Electrical Engineering-Systems, has received the 2001 Military Communications (MILCOM) Conference Award for Technical Excellence for his many years of research into spread spectrum communications, especially ultrawideband radio. He launched IMSC's UltRa Lab, a key research laboratory in the nation for the study of the promising new wireless technology of ultrawideband. Prof. Scholtz has also been a key IMSC investigator from the beginning of the Center. (See page 3.)

We had a productive joint Scientific Advisory Board/Board of Councilors meeting in the fall, and I want to thank all the participants for their participation and helpful guidance, particularly in light of our efforts to prepare for the June National Science Foundation (NSF) renewal site visit.

The IMSC organization structure has been expanded to include six research areas, each headed by a

Research Area Director. The Directors are Prof. Chris Kyriakakis for Sensory Interfaces; Prof. Alexander Sawchuk, IMSC's Deputy Director, for Media Communications; Prof. Cyrus Shahabi for Information Management; Prof. Shrikanth Narayanan for Applications Research; Prof. Irving Biederman for User Centered Sciences; and Dr. Roger Zimmermann for the Media Immersion Environment. Prof. Dennis McLeod has been appointed Strategic Scientist and will work with Deputy Director Sawchuk and me on strategic issues.

Dr. Biederman is among the new faculty members who have joined the

Center. He is a Professor of Neuroscience and Director of the USC's Image Understanding Lab (See page 5.) He adds a deep understanding of human perception and cognition to IMSC's program in User Centered Sciences.

Dr. Elaine Chew, Assistant Professor in Industrial and Systems Engineering and an accomplished pianist, will add music expertise to our sensory interfaces research. She received her Ph.D. in operations research from MIT and came to USC in the fall. Her current research applies the science of decision-making to problems in music

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## Prof. Holman wins Academy Award for improvements in cinema audio

IMSC key investigator Tomlinson Holman, a pioneer in the audio field and developer of the Lucasfilm THX Sound System®, has won a 2001 Academy Award for technical achievement for research and systems integration that have improved loudspeaker systems for movies.

Prof. Holman will receive the award at a gala dinner March 2 in Beverly Hills held by the Academy of Motion Picture Arts and Sciences to honor its 21 scientific and technical achievement award winners for 2001.

Prof. Holman, who is Professor of Film Sound in the School of Cinema-Television, has been an IMSC key investigator since the beginning of the Center in 1996.



**Prof. Tomlinson Holman**

His research at IMSC's Immersive Audio lab includes work on the 10.2-channel sound system, the next generation of surround sound. He heads TMH Corporation, an IMSC partner, which is pursuing commercialization of the 10.2-channel system.

"IMSC has provided a very collaborative environment in which we can stretch the boundaries of what can be currently commercial with a view to the longer term," he said, "and, as such, has already contributed greatly to what I believe will be the future of sound recording and production."

Prof. Holman developed the Lucasfilm THX Sound System® during the 15 years he was at Lucasfilm, Ltd. He is the primary developer and patent holder of the system, which is also known as Tomlinson Holman's eXperiment (hence the "THX"). At Lucasfilm, he spearheaded the conception, design, development and implementation,

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## *Haptics book published as first title of IMSC Press*

*Touch in Virtual Environments: Haptics and the Design of Interactive Systems* was published in December as the inaugural title of IMSC Press, a partnership of IMSC and Prentice Hall Professional Technical Reference (PTR).

The book is an outgrowth of a February 2001 haptics conference initiated and co-sponsored by IMSC that attracted nearly 80 investigators from around the world. Haptics, which comes from the ancient Greek word "haptikos," meaning "to grasp or perceive," is an innovative and fast-emerging field of touch-based technology.

### **Conference papers incorporated**

Many of the volume's chapters were first presented as papers at the conference, which was also co-sponsored by USC's Annenberg School for Communication and the Institute of Electrical and Electronics Engineers Control Systems Society.

The book's editors are Dr. Margaret McLaughlin, the principal investigator in IMSC's haptics work and Professor of Communication at the Annenberg School; Dr. Joao Hespanha, formerly an IMSC key investigator on haptics and now at the University of California, Santa Barbara; and Dr. Gaurav Sukhatme, an IMSC key investigator on haptics and Assistant Professor of Computer Science.

Dr. McLaughlin said *Touch in Virtual Environments* presents the full range of haptics research, including system control hardware, interface design, compression, capture of data, human factors, and applications. She pointed out that haptics researchers investigate the sensation of shape and

texture an observer feels when exploring a virtual object, such as a 3D model of a tool, instrument or art object.

She said researchers are interested in developing, refining, and testing haptic devices and interfaces and applying findings from psychological studies of human touch to the simulation of the tactile sensation in virtual environments.

She also said haptics is starting to have an impact on the design of immersive systems and stressed the book's contributors are working at the leading edge of engineering science.

Haptics research at IMSC includes the development of algorithms for force control; compression of haptic data; strategies for the description, storage, and retrieval of haptic data; integration of haptics into multimodal interfaces; haptic rendering of scientific data; and the psychophysics of mutual touch in immersive environments.

### **Promising applications detailed**

Dr. McLaughlin said the book details several promising applications, including surgical simulation and medical training, scientific visualization, painting, sculpting, computer-assisted design, and military training and simulation.

Contributors are affiliated with top programs in the haptics field in addition to the program at IMSC, including those at Stanford University, the University of California at Berkeley, the University of North Carolina, Carnegie Mellon University, and the Massachusetts Institute of Technology.

*Touch in Virtual Environments* is available from Prentice Hall PTR and can be ordered from the firm's Web site at <http://www.phptr.com>.

## **IMSC Press launches active publishing program**

With the publication in December of *Touch in Virtual Environments: Haptics and the Design of Interactive Systems*, IMSC Press has launched a cutting-edge multimedia and Internet research publishing program that will soon become a major asset not only for the Center, the School of Engineering, and USC, but also for the vast multimedia community as well, according to IMSC Press Editor-in-Chief Andrew G. Tescher.

He said upcoming books, planned for spring publication, will present a wide breadth and great depth of new, fundamental research in the multimedia and Internet field.

The titles include *Multimedia Fundamentals, Volume 1: Media Coding and Content Analysis* by Ralf Steinmetz and Klara Nahrstedt, *The MPEG-4 Book* by Fernando Pereira and Touradj Ebrahimi, and *Intelligent Systems for Video Analysis and Access Over the Internet* by Wensheng Zhou and C.-C. (Jay) Kuo.

IMSC Press has partnered with Prentice Hall Professional Technical Reference (PTR) to publish the books. All titles will be available from Prentice Hall PTR and promoted on its Web site at <http://www.phptr.com>.

"We are extremely pleased to have such a prestigious scientific publishing company as Prentice Hall PTR as our

partner," Dr. Tescher said.

Bernard Goodwin, Prentice Hall PTR Vice President and Publisher who is a member of IMSC's Scientific Advisory Board (SAB), said, "We are proud to be associated with IMSC and IMSC Press. Through IMSC Press, the Center is now publishing books that showcase pioneering research, which will have a major effect on the multimedia and Internet industry."

Dr. Tescher, a former Chairman of the SAB and currently member of both the SAB and IMSC's Board of Councillors, is affiliated with Compression Science Corp. in San Jose, CA.

He has spent more than 20 years in the image and signal processing field as well as in the multimedia field. Under a special assignment to Microsoft Corporation, he serves as U.S. Head of Delegation to SC29, the international standards body for the coding of audio, picture, multimedia and hypermedia information.

He said that, as the IMSC Press publishing program gets underway, he would like to acknowledge the IMSC Press Editorial Advisory Board, which is composed of Leonardo Chiariglione, Multimedia Services and Technologies, CSELT, Torino, Italy; Tariq S. Durrani, Department of Electronic and

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# Prof. Scholtz honored for wireless contributions

IMSC investigator Robert Scholtz, a long-time Professor of Electrical Engineering-Systems, has received the 2001 Military Communications (MILCOM) Conference Award for Technical Excellence for sustained contributions over his lifetime to military wireless research into spread spectrum communications, including ultrawideband (UWB) radio.

He was honored for his achievements in the field by the Military Communications Conference Board at the annual MILCOM Conference in October in McLean, Va.

Dr. Scholtz was only the fourth investigator to receive the award in the 20-year history of the conference. The award committee was composed of the three previous award winners. The sponsoring organizations are the Institute of Electrical and Electronics Engineers (IEEE) Communications Society and the Armed Forces Communications and Electronics Association (AFCEA).

"I am truly honored that the Board has seen fit to recognize my research in this way," Dr. Scholtz said.

Spread spectrum communications research is relevant to such areas as wireless voice communications, high-speed data communications and advanced radar systems. In spread spectrum communications, more radio frequency bandwidth is used than is necessary to communicate the data, providing a means for a radio to reject external interference, including jamming. The military is especially interested in spread spectrum communications for its anti-jamming capabilities. Ultrawideband radio technology is the specialty within spread spectrum communications that uses pulses of radio energy rather than radio waves to transmit information wirelessly in a digital form.

The Chairman of the award committee, Professor Laurence Milstein at the University of California, San Diego, said of Dr. Scholtz: "He has been one of the foremost contributors in moving the military communications field ahead, and he has been one of the most visible investigators nationally in the new field of ultrawideband radio."

Dr. Scholtz, who has been a professor at USC for 38 years, began investigating spread spectrum communications some 30 years ago. With three others, he wrote the key three-volume book, *Spread Spectrum Communications*. He is an IEEE Fellow and has held leadership positions in the organization.

In the early 90s, he moved into UWB research, at first consulting for the Time Domain Corporation of Huntsville, Alabama, a pioneer in the field and an IMSC corporate partner. His first publication on UWB radio was a MILCOM paper in 1993.

In 1994, he was elected Chairman of the Electrical Engineering-Systems Department and served in that position until 2000. "In the early 90s, communications research nearly dropped off the map because of the low level of federal funding, and my funded research program shrank. When I became Chairman, I tried to bring stability to the department, supporting research funding through IMSC and minimizing the paperwork that went to the faculty," he said.



*Prof. Robert Scholtz, who has received the 2001 Military Communications (MILCOM) Conference Award for Technical Excellence for contributions to military wireless research, shows an ultrawideband radio antenna set up in USC's Paul G. Allen Wireless Test Facility.*

When IMSC was established in 1996, Prof. Scholtz created the Center's Ultrawideband Radio Laboratory (UltRa Lab), and worked steadily to spark interest in UWB technology.

In 1998, he organized an IMSC workshop on UWB radio that served as a catalyst for focusing private industry concerns on regulatory constraints of the Federal Communications Commission (FCC) that hindered comprehensive research and commercialization of UWB systems. A year later, the FCC issued waivers to three companies to produce limited numbers of UWB systems and granted an experimental license to Dr. Scholtz to conduct tests outside the confines of the laboratory setting.

In 2000, through Dr. Scholtz's efforts, IMSC's research in UWB was boosted by a \$200,000 contribution by computer industry pioneer Paul Allen, a co-founder of Microsoft Corp., to build an RF anechoic chamber for UWB research. The chamber, named the Paul G. Allen Wireless Test Facility, opened on campus in 2001.

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## Jairo Umana: An MUA success story

# From student, then teacher in MUA to USC student

It's still "a little bit surreal," as Jairo Umana puts it.

That is, the fact that he has made it, that he is living his dream of becoming a USC student, beginning classes this semester.

"I'm really excited about it," he said.

Umana was in the very first class of IMSC's Multimedia University Academy (MUA) when the Center started the Academy five years ago to offer a chance to at-risk, inner city youth, aged 17-22, and others to enter the multimedia field.

He was so taken by the MUA program, which provides training in computing, multimedia and design and encourages further education and career development, that he signed on as a staff member right after he finished the five-month, part-time program.

And, at the same time, he enrolled at Pasadena City College, determined to one day become a USC student.

He had felt USC's influence for most of his life. His family lived close to the campus, and he had started school at the USC Head Start pre-school. He went to one of the University's Family of Five Schools, the 32nd Street/USC Magnet Center, which includes the Math Science Technology High School, before entering the MUA program in 1997 and then joining the MUA staff the next year.

When he became an MUA staff member, his job was to keep the equipment up and running, but after awhile, he took on teaching responsibilities as well. He began teaching Microsoft Office and then started providing "hardiness training," a regimen of techniques that instill self-confidence and discipline.

"It's great when you see a student come in who's never even touched a computer and then by the end of the class, he looks like he's been using it all his life," he said.

At Pasadena City College, Umana

focused on meeting USC's transfer requirements and succeeded last year.

"Jairo is an MUA success story," according to Mark Bielak, head of the program. "He has worked hard over the years, and, now that he's been admitted to USC, his work is starting to pay off. It's also great that he's a teacher at MUA. He's a good example for the

students: They realize that he had been where they are now and that he worked his way up to be a teacher," Bielak said.

Umana plans to take education, multimedia and business courses as he pursues his Bachelor's at the University.

He's also committed to continue working at MUA. "This job is a learning experience in itself," he said.



Jairo Umana and MUA student Ana Castellanos

## Instruction based on MUA program

# New training academy created

A new for-profit, multimedia training organization called the New Media University Academy has been created based on IMSC's Multimedia University Academy (MUA), and MUA has been transferred within USC to the Office of Civic and Community Relations (C&CR), the University's outreach arm.

"With the establishment of the New Media University Academy, we have achieved our goal of disseminating the MUA program beyond the boundaries of the University," according to Dr. Isaac Maya, IMSC's Director of Industry and Technology Transfer Programs.

Dr. Maya also said the transfer of MUA to C&CR addresses a recommendation of IMSC's Scientific Advisory Board (SAB) that the Center locate an appropriate funding organization for MUA. That recommendation was included in the SAB's annual SWOT (Strengths, Weaknesses, Opportunities and Threats) report to the National Science Foundation last year.

IMSC's MUA developed a multimedia curriculum for at-risk youth, aged 17-22,  
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## Prof. Biederman named as new Research Area Director

Dr. Irving Biederman, the Harold W. Dornsife Professor of Neuroscience at USC, has recently been named Director of IMSC's User Centered Sciences Research Area.

"I'm delighted to have the opportunity to be working with the outstanding group of scientists now at IMSC," he said. "The problems that we have been working on dovetail nicely with IMSC's mission."

As an example, he cited his work on developing a neurocomputational account of perceptual and cognitive pleasure based on the discovery of a gradient of enkephalin receptors in particular areas of the cortex. Enkephalins are natural opiates produced by the brain that induce pleasure. He explained that these areas are responsible for higher level perceptual processing, involving the activation of representations of previous experience. And, he said, as IMSC researchers develop audio, visual and haptic (touch-based) technologies to immerse the user in ever-greater integrated sensory stimulation—thus allowing for more facile comprehension—the greater the opportunity for maximizing the kind of cortical activity that results in user pleasure.

He pointed out that this bodes well for the potential benefits of integrated media systems, saying his research implies that the greater the rate at which we can process novel but interpretable information—through such means as 3D spatial media, body movement or multiple modalities—the greater the pleasure. He explained the simple reason for this is that the greater the activity in higher-level perceptual areas in the brain dealing with comprehension, then the greater the amount of enkephalin activity. This neural activity is generally experienced as being pleasurable.

Some of Dr. Biederman's experiments assess the maximum rates at which people can assimilate visual information. In these experiments, people fixate at a screen and scenes they have not seen before are presented at rates of about 10-15 per second. The observer's task is to detect a particular scene, defined quite abstractly as "happy tourists" or "a market."

"On their own, people can make about two to three eye movements per second, but the brain can readily comprehend novel scenes at least five times faster," Dr. Biederman said.

"It seems that the brain has evolved to move faster than the eyes. Moreover, doing these tasks is great fun, a bit like playing a video game. This underutilized capacity of the brain would appear to be ripe for exploitation by immersive media."

Dr. Biederman's other major research interests also have direct bearing on IMSC's work in such areas as shape, object and scene perception; face recognition; and the neuroscience of object recognition. He said he is pleased that IMSC is focusing so strongly on the user centered sciences to complement the Center's technology research.

Prof. Biederman, who is also Director of USC's Image Understanding Laboratory, has taught at USC since 1991 and holds appointments in the Departments of Psychology and Computer Science. He has authored more than 100 scientific publications. He has been a member of panels for the Na-

tional Science Foundation, National Research Council and Air Force Office of Scientific Research, where he served as the first Program Manager for the Cognitive Science Program. Prior to coming to USC, Dr. Biederman was the Fesler-Lampert Professor of Artificial Intelligence and Cognitive Science at the University of Minnesota.



Dr. Irving Biederman

## Prof. Holman honored . . .

(Continued from page 1)

mentation of the technical infrastructure for George Lucas' Skywalker Ranch and the Skywalker Sound post-production facility.

For more than 20 years, Prof. Holman has been involved in research in cinema sound systems, including a two-week stint in a multiplex theater in Arkansas during his sabbatical last year, which has resulted in new findings affecting sound systems and acoustics of the latest, stadium-seating theater designs. He is founding editor of "Surround Professional" magazine, and author of *Sound for Film and Television* and *5.1 Surround Sound Up and Running*.

He is an honorary member of the Cinema Audio Society and the Motion Picture Sound Editors group. He is a fellow of the Audio Engineering Society, the British Kinematograph Sound and Television Society and the Society of Motion Picture and Television Engineers. He is a member of the Acoustical Society of America and the Institute of Electrical and Electronics Engineers.

## Prof. Chew brings music expertise to IMSC's research

Dr. Elaine Chew, a new IMSC investigator who brings music expertise to the Center's cross-disciplinary research program, is already involved in an unusual project, "Flying Sonics!" which promises a multichannel electro-acoustic musical extravaganza this spring.

### New academy . . .

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and others, and has offered six part-time programs. Nearly 100 students have completed the course of study, and close to 80 percent found positions in the multimedia industry or are pursuing further education. This MUA curriculum is licensed by the newly created organization, the New Media University Academy.

Under a contract with the City of Los Angeles, the New Media University Academy has started a program at the city's Community Technology Education Center (CTEC), according to Mark Bielak, the MUA Director who is now President of the new for-profit academy. Bielak also continues to operate the training program for USC's Civic and Community Relations Office, which has a separate contract with the city's Housing Authority to train city residents who live in public housing. Both 20-week programs started last month with 18 students apiece.

The concert will feature compositions for two grand pianos and multichannel audio generated and controlled by computers.

Dr. Chew, an Assistant Professor in Industrial and Systems Engineering and a classical pianist, will perform on one of two nine-foot grand pianos on stage at the Alfred Newman Recital Hall. Dr. Dennis Thurmond, an Associate Professor of Keyboard Studies and Director of ElectroAcoustic Media at the Thornton School of Music, will play the other one.



**Prof. Elaine Chew**

As the pianists perform, Dr. Chris Kyriakakis, another IMSC investigator and Assistant Professor of Electrical Engineering-Systems, will use IMSC's multichannel Immersive Audio technology to generate accompanying sounds that will be dynamically placed in space throughout the hall.

Calling the show a "landmark performance art event," Dr. Chew said that it will "push the boundaries of an interactive technology-acoustic partnership in concert."

She said "the sounds we'll be producing on the pianos will interact

with the computer-controlled sounds that are darting and spiraling through space. The spatial dimension afforded by the multichannel technology will open up new musical realms for exploration."

She pointed out that new music will be composed for the performance that will exploit the 3D audio as a new parameter for musical expression and creativity.

A Faculty Collaboration Grant from the USC Arts Initiative will fund the performance. The concert will probably take place in mid-April and will be publicized across campus in advance.

Dr. Chew, who came to USC this past fall, said the "Flying Sonics!" project is an excellent example of the kind of interdisciplinary research that drew her to IMSC. "I really love the environment. There's an adventurous spirit at IMSC," she said.

"Music is the ideal domain for studying human perception and cognition, communication and creativity," she said, explaining that her goal is to apply the science of decision-making, called operations research, to the domain of music.

Dr. Chew combines her training as an operations researcher with her experience as a practicing musician to build efficient and cognitively viable

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### Prof. Scholtz honored . . .

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Dr. Scholtz said the Allen test facility enables careful measurement of UWB signals in a controlled electromagnetic environment. He pointed out that the facility allows researchers to characterize UWB radio antennas without having to worry about the multipath effects and interference that normally occur in a laboratory environment.

Dr. Scholtz also strengthened IMSC's UWB research in 2001 when he led a team that won a three-year, \$3.6 million grant from the U.S. Army to investigate critical problems occurring in short-range UWB radio applications. In addition to researchers from USC, the team includes investigators from the University of California at Berkeley and the University of Massachusetts at Amherst.

In reflecting on his work at USC, Dr. Scholtz said he hopes a lasting contribution will be the building of a strong radio laboratory, the UltRa Lab.

"In the School of Engineering, we have a core of young faculty who are very good. I would like to help the School by continuing to build a radio laboratory and experimental radio program that will do the School proud," he said. Dr. Scholtz was Director of the School's Communication Sciences Institute from 1984 to 1989.

### IMSC News

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## BOC/SAB members review IMSC at joint meeting

A joint meeting of IMSC's Board of Councillors (BOC) and Scientific Advisory Board (SAB) was held in November on the USC campus.

Board members reviewed IMSC's research and other activities and provided advice and counsel to the Center.

Break-out sessions were held on "Future Industry Collaboration—Intellectual Property, Industry Membership and Consortia," "IMSC's Vision: Ensuring Leadership in the

Multimedia Technology Future," and "The Future Evolution of the Media Immersion Environment Framework and Test Bed."

The BOC is composed of leaders in the multimedia industry who provide strategic counsel to the Center.

The SAB members are representatives of the Center's corporate partners, who meet semi-annually to review IMSC's research, education, industry and outreach programs.

## Director's Message: IMSC expands research structure . . .

*(Continued from page 1)*

perception and cognition; visualization and representation of musical data; and knowledge-based categorization and retrieval of musical information (See page 6.)

Dr. Leana Golubchik, Associate Professor of Computer Science, joins IMSC this semester from the University of Maryland at College Park. Her research interests are personal information sensing, storage and query; computer systems modeling and performance evaluation; and Internet-based computing.

We have also had some staff changes. Nichole Phillips has been appointed IMSC's Executive Administrative Director. She has served as Chief Financial Officer since the beginning. She replaces Sue Lewis, who has become Assistant Dean for Program Planning and Design in the School of Engineering. Victoria MacKenzie, formerly a Contracts and Grants Administrator for the University and the Information Sciences Institute, has joined IMSC as Business Manager. (See page 8.)

Victor LaCour, who has conceived and designed high-end Web sites in the entertainment field, joins the Center as Creative Producer. Victor develops visualizations and presentations of IMSC technology, experiments, and identity for the IMSC Web site and other media, including print, video, CD-ROMs and DVDs. He also facilitates creative collaborations with other Schools at USC as well as with other universities.

John P. Lewis is a new Research Associate in Animation. He brings

extensive knowledge about animation for entertainment, and his experience includes positions as Head of Research and Development at Centropolis Effects and as Director of Software Research

and Development at Dream Quest/Disney TSL. I look forward to working closely with these new faculty and staff, and I know we will have an active and productive spring.

### Dr. Neumann speaks on Augmented Reality

IMSC Director Ulrich Neumann gave an invited talk on Augmented Reality (AR) at the Second International Symposium on Augmented Reality held last October at Columbia University in New York City.

The two-day symposium was sponsored by the Institute of Electrical and Electronics Engineers (IEEE) and the Association for Computing Machinery.

Dr. Neumann's presentation, entitled "AR Out of the Box," discussed the state of AR research as well as new developments and emerging trends.



**INTEL VISIT**—Intel representatives visited IMSC and other School of Engineering facilities in October. Intel has been an active IMSC partner over the years. From left to right: Jeanette Harrison, Director, TMG Training; Craig Walker, Senior Engineer, Campus Recruiting Manager; and Terri Durban, Project Manager, Technology for Education.

## IMSC Press . . .

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Electrical Engineering, University of Strathclyde, Glasgow, Scotland; Jeff Gralnick, E-splision Consulting LLC, Weston, CT; Max Nikias, Dean of Engineering at USC and former IMSC Director; and Adam C. Powell III, McLean, VA.

Dr. Tescher said contributions are welcome for consideration and potential contributors should contact him at andytescher@attbi.com.

Potential topics include many categories of multimedia technologies, such as multimedia systems, relevance of standards, the role of multimedia in education, the convergence of computing and broadcast, hardware implementations, the impact on social issues, and multimedia and entertainment.

## Prof. Chew . . .

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computer models for representing, analyzing, categorizing and comparing musical information.

She said these quantitative models will provide the means to attain her ultimate goal of explaining the role of decision-making in music performance.

In her doctoral research at the Massachusetts Institute of Technology (MIT), she came up with a 3D model for representing musical information that has been used successfully to develop real-time algorithms for music perception and cognition. The model enabled the design of an algorithm for key-finding

that performed more efficiently than current methods on a canonical test set.

Also, the model allowed the design of the first computationally viable algorithm for detecting key modulations. She said that key change is one important way to segment a piece of music.

Dr. Chew, who grew up in Singapore, was an award-winning pianist by the time she was in her teens. She earned her Bachelor's degree in Mathematical and Computational Sciences and Music from Stanford University and holds a Master's and Ph.D. in Operations Research from MIT.

## Phillips, MacKenzie named to posts

Nichole Phillips has been appointed IMSC's Executive Administrative Director, replacing Susan Lewis, who was named Assistant Dean of Program Planning and Development of the School of Engineering.

Ms. Phillips has served as the Chief Financial Officer of the Center since its inception in 1996. Prior to that, she was the Research Coordinator for the School.

Victoria MacKenzie, who was a Contracts and Grants Administrator for the University, has been named IMSC's Business Manager. Ms. MacKenzie has also been a Contracts and Grants Administrator for the Information Sciences Institute.

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