IMSC News

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Director's Message

IMSC prepares for major NSF review

This spring we are all busy preparing for the National Science Foundation's (NSF) upcoming, critical three-year review of IMSC.

First, an NSF site review team will visit the Center from May 18-20, and then Deputy Director Alexander Sawchuk and I will travel to Washington, DC, to present to an NSF Blue Ribbon review panel on June 10.

Chrysostomos L. (Max) Nikias

The IMSC staff and investigators have been gearing up for months to meet the challenge of this important review.

We will be showcasing our many notable accomplishments of the past several years. Although IMSC is relatively young, we have already reached a number of important milestones.

The Center's Grand Challenge System Integration Experiment, the Media Immersion Environment (MIE), provides a framework to target low-cost high-performance solutions for integrating all multimedia technological developments by IMSC and others. At the same time, the MIE engages students in a truly cross-disciplinary view of engineering.

The MIE is becoming a national testbed for the development of a powerful new 3D teleconferencing system, and we are preparing to conduct experiments with Internet-II connectivity.

Our research program has been structured to attain vertical and horizontal integration on three levels. Basic research at the bottom level drives requirements of the MIE and enabling technologies at the middle level, with new applications being developed at the top level. In turn, the evolving applications drive new requirements for the MIE and enabling technologies, propelling basic research in new directions.

We have developed such unique immersive technologies as 3D face modeling and animation, video rendering methods from multiple projections and immersive 3D directional sound environments.

Our research in data compression has earned IMSC prestigious awards in a recent worldwide JPEG 2000 standard competition.

The immunology module of IMSC's BioSIGHT project, which is

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IMSC profs give historic sound demo

In a landmark audio event, IMSC key investigators gave the first 10.2-channel sound demonstration at the national Consumer Electronics Show in Las Vegas in early January.

Prof. Tomlinson Holman and Prof. Chris Kyriakakis played custom-recorded concerts, sound effects and other spatial sounds for key audio retailers, installers and press personnel.

One of the attendees, Michael Riggs, declared in *Surround Professional* magazine that "the vividness of the acoustical representation was simply astonishing."

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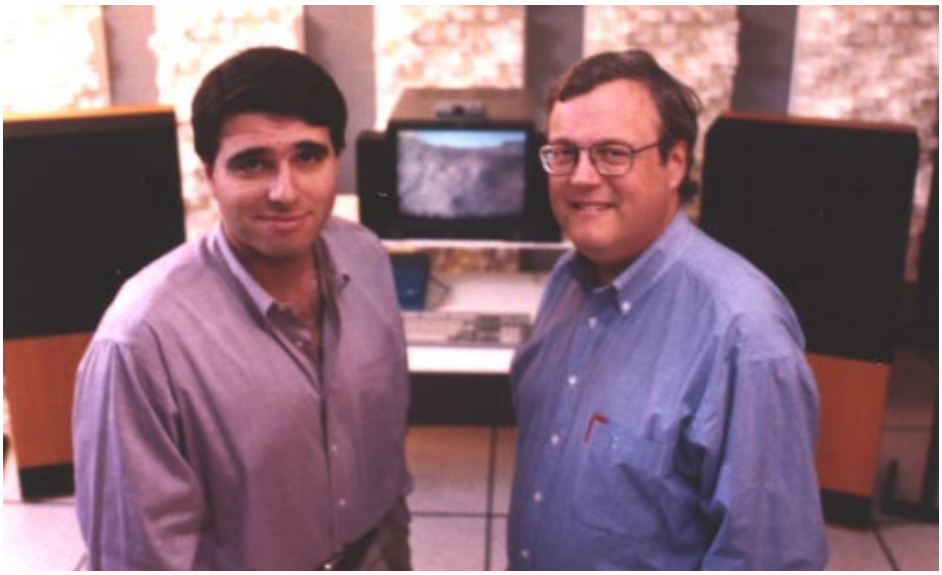

Photo by USC Photographer Irene Fertik

Chris Kyriakakis (left) and Tomlinson Holman in IMSC's Immersive Audio Lab.

Inside *IMSC News*

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Intel strengthens major role as corporate partner

Intel Corp. recently strengthened its already major role as an IMSC corporate partner.

In January, the firm named USC as one of its 15 "Focus Schools," a distinction that means the university will have twice-a-year opportunities to apply for equipment grants and undergraduate and graduate fellowships.

IMSC will directly benefit since Intel's interests are primarily in the areas of computer science, computer engineering and electrical engineering.

For the past two years, Intel has been contributing personal computers with Intel processors and Intel-made network hardware to IMSC through a three-year grant under its Technology for Education 2000 program. The company is also providing funding support to IMSC's research in compression and broadband networks.

Prof. Alexander A. Sawchuk, IMSC's Deputy Director, pointed out that Intel's contributions have helped to build the Media Immersion Environment (MIE), IMSC's developing national testbed for multimedia research. The MIE connects more than 100 computers and servers in distributed clusters via high-speed asnychronous transfer mode (ATM) links.

INTEL REPRESENTATIVES VIEW IMSC PROGRESS—*Student Doug Fidaleo shows face modeling and animation of his own face to two Intel visitors, Jeanette Harrison, Director, TMG Training (center), and Susan Wilson, Account Manager.*

"Intel's continued support is helping us reach our goal of extending the MIE from a local area network running at high speed to the Internet-II," Sawchuk said.

George Bourianoff, Technology Manager for Intel's Technology for Education 2000 program, praised IMSC's work, saying, "It's clear that IMSC is a leader in multimedia technology development in the country."

Bourianoff said Intel's technology in education program has two aims: Make the Intel platform the architecture of choice on college campuses and advance the capabilities of Intel technology.

He pointed out that IMSC is helping to advance these capabilities by pushing the Intel computer technology to its limits in its multimedia research.

Bob Liang, the Director of Intel's Multimedia Graphics Lab and a member of IMSC's Board of Councillors (BOC), also lauded IMSC. He visited the Center for last November's initial annual BOC meeting. Liang was especially impressed by IMSC's approach in applying new research findings to real-world situations. He said that, in contrast to research efforts at some other universities, "IMSC is trying to solve real-world problems by developing an environment in which the new technology is actually used."

Photo by Dan Avila

NSF VISITOR—*Dr. Eugene Wong (right), Assistant Director for Engineering of the National Science Foundation, was given a tour of IMSC by Chrysostomos L. (Max) Nikias, IMSC's Director, when he visited the Center last December. Dr. Wong cited information technology, microelectronics and biotechnology as three of his top strategic thrusts. He heard presentations on IMSC's research, industry relations, technology transfer, education and community outreach programs.*

IMSC's Deputy Director wears many hats

As Deputy Director of IMSC, Prof. Alexander A. (Sandy) Sawchuk wears many hats.

He is responsible for managing the infrastructure of the IMSC Media Immersion Environment (MIE), a software and hardware platform that serves as the integration focal point for IMSC research.

Alexander A. (Sandy) Sawchuk

He is also responsible for the allocation of lab space and coordination of efforts among IMSC's research groups, and he directs research in one of IMSC's three research areas—Media Communications (MC), which targets existing barriers to fast and efficient delivery of real-time multimedia information.

Views himself as "systems person"

Sawchuk, who has been a professor of electrical engineering at USC for 27 years, views himself as a "systems person." He has been a leading member of the IMSC management team from the start of the Center in 1996. He is also Associate Director of USC's Signal and Image Processing Institute.

His technical background includes work on digital image processing, signal processing and optoelectronic devices and systems for high performance computing, networks and communications.

He holds a Ph.D. and an M.S. in Electrical Engineering from Stanford University, and the S.B. degree from the Massachusetts Institute of Technology.

Sawchuk is a Fellow of the Institute of Electrical and Electronics Engineers (IEEE), the Optical Society of America (OSA) and the International Society for Optical Engineering (SPIE).

He received the 1980 Halliburton Award for Exceptional Service, the 1993 Lockheed Senior Research Award and the 1995 Outstanding Teaching Award from the USC School of Engineering.

MIE as national testbed

Sawchuk said that the MIE is developing as a national testbed for multimedia research. Recent improvements in the MIE include the upgrading of the IMSC computer network to a higher speed fiber optic network, connecting the Center's research labs to each other, to the campus network, to the current Internet and to the evolving Next Generation Internet (NGI).

Currently, more than 100 computers and servers are interconnected in distributed clusters by high-speed asynchronous transfer mode (ATM) network links.

As Associate Director of Research for the Media Communications research area, Sawchuk coordinates the work of more than nine key faculty investigators working to develop hardware and software capable of transmitting large amounts of data over distributed networks with extremely high data rates and very low delay.

Digital video and other multimedia data require data rates of hundreds of megabits per second or more, and these rates exceed the rates of most existing networks. Consequently, high performance workstation processors and interfaces are needed to link computers to such a network.

Completely new approaches needed

Sawchuk said that solutions to such media communications problems will be found only with completely new approaches, including advanced video compression, which uses features extracted from the video, and new mathematical signal representations, which reduce the redundancy in the transmitted information.

Sawchuk pointed out that some of IMSC's recent successes in the Media Communications area include a new multi-threshold wavelet compression algorithm that outperforms other algorithms in compressing multi-spectral and color images, and real-time, low delay uncompressed video transported over an ATM network, using commonly available hardware architectures.

IMSC Student Conference to stress entrepreneurship

With the slogan, "Turning Data into Dollars," the Third Annual IMSC Student Conference will focus on the entrepreneurial and economic aspects of multimedia on April 16 at the USC Davidson Conference Center.

The day-long conference, organized by the IMSC Student Assembly, is open to all USC students.

Students will present research papers in a competition for the best student paper, according to David Taylor, vice president of the IMSC Student Assembly and chair of the conference. Students will also set up displays and give demonstrations of their work.

Technical personnel as well as human resources representatives from multimedia companies will be on hand to present a comprehensive overview of their firms. The technical specialists have been invited to give lecture-style presentations as well as exhibit table demonstrations.

Conference organizers called on IMSC's Scientific Advisory Board (SAB) members in developing the invitation list of corporate representatives. SAB members represent blue-chip companies and smaller firms in the multimedia industry.

This year, IMSC students worked with USC's Marshall School of Business to bring in expertise in entrepreneurial development. Tom O'Malia, director of USC's Entrepreneur Program, will give a special presentation on entrepreneurship. The Entrepreneur Program was recently ranked No. 1 in the nation by *Success* magazine. Alumni of the Entrepreneur Program have also been contacted to participate.

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Lewis provides management assistance to new ERCs

Sue Lewis, IMSC's Executive Administrative Director, recently provided management expertise to new National Science Foundation (NSF) Engineering Research Centers (ERCs) as part of a project by NSF to give a jump start to its new Centers in establishing their operations.

Ms. Lewis was on a team that made recent two-day visits to provide technical assistance to five new ERCs located at Clemson University, Georgia Institute of Technology, Johns Hopkins University, University of Hawaii and Virginia Institute of Technology-Polytechnic University.

Sue Lewis

Other members of the ERC team included Marianne Risley, Administrative Director of the Center for Emerging Cardiovascular Technologies at Duke University; Alma Weightman, Operations Manager of the Center for Biofilm Engineering at Montana State University; and Buz Smith, Budget and Finance Officer at the Center for Optoelectronic Computing Systems at the University of Colorado. Joining the team was John Theis of Quantum Research Corporation, a specialist in information management systems.

Lynn Preston, NSF's Deputy Division Director for Engineering, said of the project, "The National Science Foundation believes that it's important to provide our newest ERCs with the valuable expertise of seasoned ERC managers so they can come up to speed quickly."

Ms. Lewis brought two key elements to the team—first, she has been a part of the management team of two ERCs in their start-up phase and, second, the two Centers are relatively new, thus functioning under the newest guidelines from NSF. Her first start-up ERC was the Center for Neuromorphic Systems Engineering at the California Institute of Technology, and the second is IMSC. She was the Assistant Director of the Center at Caltech. The other members brought various expertise, including longevity with older NSF ERCs in differing university settings.

During the past few months, the team made a trip to each new Center, consulting for two days with the Center director, faculty and staff as well as with key administrators at the host university who will interact with the Center.

"We told them that running an ERC is different than anything you've ever done before," Ms. Lewis said.

She pointed out that one of the goals of an NSF ERC is to "change the culture." Today's ERCs are expected to promote a multidisciplinary educational experience for the new generation of engineering students and create effective community outreach programs, among other activities.

Team members used the Engineering Research Center Best Practices manual for guidance. "This manual was developed several years ago by ERCs for ERCs," Ms. Lewis said, "and, in a sense, we were a living form of the manual." The consultant team advised in such specific areas as Center administration and staff management, financial administration, strategic planning, industry relations and community outreach. Additionally, the team is developing recommendations on how information gathering and the NSF reporting can be improved.

"Overall, I think we were able to assist the Centers in important areas. Our goal was not to configure systems for them, but rather, to provide guidance with planning for their future needs based on effective systems already in place at other ERCs," Ms. Lewis said.

USC President Sample visits IMSC

USC President Steven B. Sample was briefed on the IMSC's progress in a visit to the Center in February. He heard presentations by IMSC Director Prof. Chrysostomos L. (Max) Nikias and key faculty investigators.

In IMSC's Powell Hall laboratory, President Sample talked with Prof. Ulrich Neumann, IMSC Associate Director for Research in computer interfaces, about immersive telepresence research (above), and tried on a device that displays a virtual classroom that is being developed by Prof. Albert (Skip) Rizzo, an IMSC key investigator, for the assessment and possible treatment of attention deficit disorder (ADD) in children (below).

Biology students become "virtual" scientists

Biology students and their teacher at Newbury Park High School became "virtual" scientists in February when they tested the immunology module of IMSC's BioSIGHT project.

Using laptops contributed by IMSC corporate partner IBM, the budding biologists worked with truly interactive multimedia visualization tools in exploring how poison ivy and asthma affect the body and deciding on possible treatments.

The pilot study was the first classroom test of BioSIGHT, which uses advanced multimedia techniques to map a high school biology curriculum into interactive visualization modules.

Dr. Wee Ling Wong, IMSC's principal investigator on the project, pointed out that BioSIGHT's interactivity and visualization are geared to spark an enthusiasm for biology in a generation accustomed to the fast pace and colorful animation of video games.

There are three elements to the module—the exploratory challenge that introduces complex scientific concepts in the form of a puzzle, the interactive storyboard that uses advanced multimedia tools to convey content for individual exploration, and collaborative investigations that involve simulated experiments and virtual tools, such as a virtual reagent kit and virtual microscope.

IMSC carried out the February classroom implementation pilot test in cooperation with two partners—TERC, a nonprofit research organization in Cambridge, Mass., and the Center for Technologies in Learning (CTL) of SRI International in Menlo Park, Calif.

TERC provided pedogogical expertise, and CTL conducted the assessment and evaluation. The data collected by the team will be useful in providing feedback for the pedagogical and software design issues of BioSIGHT's module.

Dr. Robert Kozma, who heads the CTL project staff, said that all 11 students were given a pre-test and post-test to determine how their knowledge increased. They also filled out an activity sheet on the use of the materials. In addition, the class was videotaped.

***"VIRTUAL" SCIENTISTS**—Biology teacher Kristi Ahrens instructs students (from left) Allison Branham, Kamyar Hosseinian and Yoshi Kuwabara during BioSIGHT pilot study.*

The evaluators also used additional assessment techniques with a small group of three students. Dr. Chris Hoadley, a specialist on technology and cognitive science with CTL, also participated in the project.

Karen Clay from TERC was involved in developing scenarios for the collaborative investigations.

Newbury Park High is one of several schools collaborating on BioSIGHT with the strong support of Principal Max Beamon. Veteran biology teacher Kristi Ahrens guided the students through the pilot study.

Dr. Wong's team at IMSC includes five IMSC professors: Prof. Gerard Medioni, for graphics and immersivision; Prof. Jay Kuo, for compression; Prof. Chris Kyriakakis, for audio; Prof. Cyrus Shahabi, for databases; and Prof. Sherali Zeadally, for network architecture.

Other IMSC staff include Eduardo Carriazo, a scientific illustrator and graphic designer; Jason Dziegielewski, an educational software designer; and student animators Joseph Dziegielewski, Daniel Ferraz and Brian Outlaw.

Student conference . . .

(Continued from page 3)

The conference will begin at 9 a.m. for breakfast and registration and end at 7 p.m. after the award presentation.

The student conference planners have designed the event so that attendees can be selective about what they want to see and move easily from one session to another without having to stay for the entire day. Break-out sessions will cover such topics as industry interaction, new student involvement and undergraduate participation.

Multimedia University Academy changes lives

IMSC's Multimedia University Academy (MUA) changes lives.

Take, for example, Lupe Iracheta, who graduated from MUA's second annual program in February.

Lupe has had a part-time job at McDonald's ever since she was a sophomore in high school. But she wanted something better.

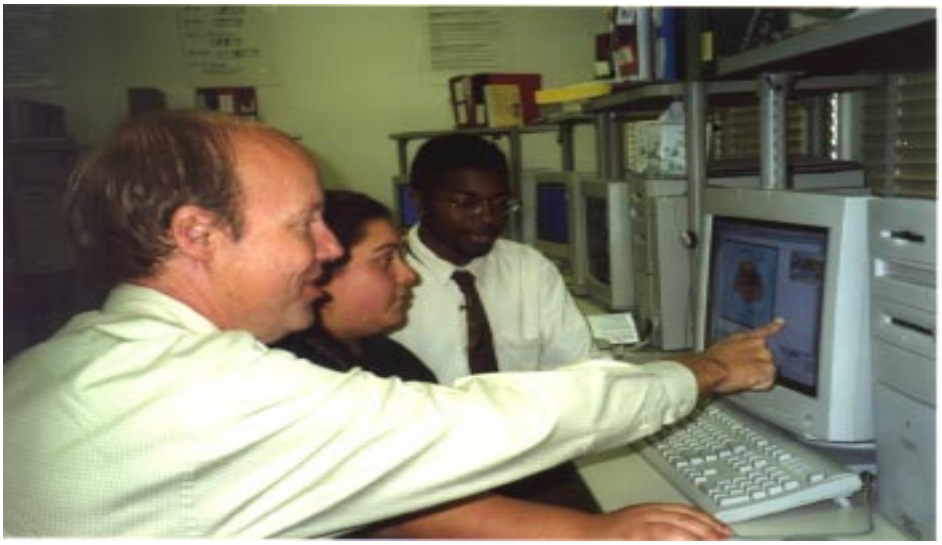
So she applied for the MUA program, one of IMSC's major community outreach initiatives that trains at-risk, inner city youth from 17 to 22 years old in multimedia and then assists them in securing entry-level positions or further education in the field.

Lupe had heard about the MUA at a Career Day at her high school, Woodrow Wilson Administration of Justice and Law magnet school in Los Angeles, a few miles from the USC campus. After she was accepted, she started the 22-week, 20-hour per week program last August.

"I knew word processing basics, but I wanted to learn more about computers," she said. "I was interested in art, too, and I realized that MUA would give me that combination."

At MUA, she learned to use such graphic design software packages as Illustrator and Photoshop. And she found that she was able to learn much faster than she did in high school.

"At MUA, the style of teaching was better. We learned more in less time, but we still learned it well," she said.



MUA IN ACTION—*MUA Coordinator Mark Bielak points out an application problem to Lupe Iracheta and David Fuggins, MUA's Multimedia and Technology Coordinator.*

Lupe also found that she needed assistance in math—and MUA provided that, too. She was tutored by a USC graduate student as preparation for the community college math entrance test. Students also get help improving their English and writing skills.

In fact, MUA provides instruction for the full gamut of student needs. A core skills program teaches successful strategies and principles in learning, test-taking, teamwork, self-regulation, business management and conflict management. Students learn how to create one-year and four-year career plans, education plans and financial plans. They follow step-by-step procedures to meet long-term goals.

The technical course of study provides students with two options—a foundation in technical administration or a grounding in digital graphics and design. In the technical administration option, students prepare for the Windows NT and Photoshop certification tests. In the digital graphics and design option, they train in industry-based multimedia software and work toward Photoshop certification, so they are ready to start productive work from Day One in new jobs. For work with various media—graphics, animation, video, audio, images, and text—they learn such programs as PageMaker, PowerPoint, Director, Soundedit, Premiere and Dreamweaver. They also learn computer principles.

And students learn the most important skill of all—how to teach themselves, according to David Fuggins, MUA's Multimedia and Technology Coordinator. Many times, companies have their own proprietary software and need someone who can learn it fast. With MUA's emphasis on principles, graduates can learn to use the proprietary software easily and quickly.

Students develop portfolios of their work and participate in IMSC research projects. Some 28 students have graduated from the two MUA certificate programs, and a majority are continuing their education at community colleges.

As for Lupe Iracheta, she has set her sights on coming back to USC as an undergraduate in a couple of years. First, she plans to apply to El Camino Community College and continue her multimedia education there. She believes that MUA has indeed changed her life: "MUA taught me a lot of new things and enhanced my sense of responsibility. I know that I really grew as a person."

For more details on MUA, go to IMSC's Web site at http://imsc.usc.edu/Education/mua.html and MUA's Web site at http://mua.usc.edu.

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Immersive audio . . .

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"Listening in a tiny, darkened room to 10-channel recordings played back over a 10.2-channel sound reproduction system, I found it very easy to believe that I was hearing live sounds in spaces much larger and very different in configuration from the one I was sitting in," he wrote.

In preparation for the demonstration, the two professors traveled to Symphony Hall in Boston a month earlier and recorded the concerts by the Handel and Haydn Society at the same time they were being broadcast in surround sound over WGBH, Boston's public broadcasting station.

The demonstration was sponsored by a consortium of firms that included Holman's company, TMH Corporation; Genelec of Finland; Techstream of Australia; Soundstream of Sacramento; and MP&A of New York.

The 10.2 channel demonstration went far beyond the latest DVD technology, which only allows 5.1 channels.

"5.1 was a compromise that came about because of storage limitations and is really not enough to reproduce the sound of something as complex as a good concert hall. The new DVD audio disc has the capacity, but the number of channels is still being limited to 5.1. We wanted to show that there is a dramatic improvement that can be achieved by increasing the number of channels," Holman said.

Holman is pioneer in audio field

Holman is one of the pioneers in the field of audio. He was the corporate technical director for Lucasfilm, Ltd., for 15 years. During that time, he spearheaded the conception, design, development and implementation of the technical infrastructure for George Lucas' Skywalker Ranch and the Skywalker Sound post-production facility. He is the primary developer and patent holder of the Lucasfilm THX Sound System®, also known as Tomlinson Holman's experiment (hence the "THX").

Kyriakakis said that "it may sound impractical to have 10 loudspeakers in the room, but 10 channels does not have to mean 10 loudspeakers. The virtual loudspeaker technology that we are developing in the IMSC Immersive Audio Lab will allow 10 channels to be rendered over five and maybe over two loudspeakers."

***AUDIO DEMO**—Alexei Ossadtchi, an IMSC graduate student, stresses a point to Athanasios Mouchtaris, another IMSC graduate student, in an immersive sound demo.*

This demonstration showcased just one notable innovation emanating from IMSC's Immersive Audio Lab, which focuses on signal processing methods for capturing and reproducing three-dimensional sound.

IMSC investigators are working on improving sound for desktop computers, among other activities.

Kyriakakis pointed out that the creation of a seamless aural environment requires not only the accurate reproduction of the measurable characteristics of sound, but the accurate spatial reproduction of sound as well.

The goal of Kyriakakis and Holman is to reproduce three-dimensional sound fields that preserve the desired spatial location, frequency response and dynamic range.

Many uses for 3D sound fields

Such sound fields could be used in multimedia applications for teleconferencing, manufacturing, entertainment, air traffic control, pilot warning and guidance, assisting people who are visually or aurally impaired, distance learning and professional sound and picture editing for television and film.

One recent innovation developed in the audio lab is the use of a camera to track head movements so that sound can be directed correctly to the ears even when a person is moving around the room. IMSC audio lab researchers developed a novel method of tracking the head that is not based on traditional computer vision methods.

Four industry partners involved

Four industry partners are currently working with IMSC on various projects in this immersive sound research. They are NXT Loudspeakers in Cambridge, England; Texas Instruments in Dallas, TMH Corp. in Los Angeles and Kodak in Palo Alto.

NXT Loudspeakers is interested in using research results in the development of new flat-panel loudspeakers and Texas Instruments is working with IMSC investigators to bring these advanced algorithms to personal computers using the company's powerful digital signal processing chips.

For more details on IMSC's immersive audio research, go to IMSC's Web site at http://imsc.usc.edu/Research/ci/immersiveaudio.html and the Immersive Audio Lab's Web site at http://audiolab.usc.edu.

Director's Message . . .

(Continued from page 1)

mapping a high school biology course into interactive modules, has had its first testing, assessment and evaluation in the classroom.

We are involved with more than 30 blue-chip technology firms and a number of small companies in cooperative research and development, including our successful collaboration with TMH Corp. in immersive audio work that was reflected in a system used by director James Cameron in making the film soundtrack for *Titanic*.

We have collaborated with USC's Fisher Gallery on an Interactive Art Museum project designed to give the "haptic" touch and feel sensation of museum objects.

Our Ultra-Wideband Radio Laboratory has been instrumental in organizing industry interaction with the Federal Communications Commission in its deliberations on developing regulatory policies toward ultra-wideband radio transmission.

We have enjoyed great success with our education initiatives, designed to train a new generation of multimedia specialists. More than 220 USC students have graduated from our education programs, which include specializations in multimedia in both the Master's Degree in Computer Science and the Master's in Electrical Engineering and in two undergraduate minors. And, just this academic year, we have implemented a Master's Degree in Integrated Media Systems. Another education program has retrained and placed more than 150 displaced workers into new jobs in multimedia and entertainment.

Our Multimedia University Academy (MUA), a community outreach program, has enjoyed much success. The MUA assists at-risk, inner city youth from 17 to 22 years old in securing careers in multimedia. MUA students receive a multimedia certificate after completing the 22-week, 20-hour per week program. We have graduated two classes, totaling 28 students, with a majority going on to community college or employment in multimedia. Additionally, we are developing partnerships with community-based organizations to disseminate the program in the community.

I am especially proud of the vigor and dedication of IMSC's investigators, students and staff in building IMSC over the past several years. I know we will be ready to put our best foot forward for the NSF review as we present our progress not only in research, industry collaboration and technology transfer, education and community outreach, but also our strategic plan for the next decade with a specific technology roadmap for the next five years.

IEEE journal spotlights IMSC

IMSC was spotlighted in the January special issue of the *IEEE Signal Processing Magazine* on integrated media systems. IMSC Director Chrysostomos L. (Max) Nikias was the guest editor, and several articles by IMSC investigators were featured. Copies of the edition are available from IMSC upon request. Email: imsc@imsc.usc.edu.

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