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## Director's Message

### IMSC developing Five-Year Transition Plan

We are developing a Five-Year Transition Plan as a roadmap for self-sufficiency after our National Science Foundation (NSF) Engineering Research Center (ERC) grant expires in



**Prof. Ulrich Neumann**

2007, and we presented a draft to the joint meeting of the IMSC Board of Councilors and Scientific Advisory Board in November for comments.

We appreciate our Board members' active participation and suggestions, and their input will be reflected in the final version.

The recent interest on self-sufficiency from NSF led to a special session on the topic at the recent annual ERC meeting. Nichole Phillips, IMSC's Executive Administrative Director, summarized the IMSC plan in this session, and her talk was well received.

Under IMSC's plan, the Center will focus its research and funding efforts in three Core Science areas: Decision Support, Collaborative Systems, and Serious Games.

IMSC has an established track record in these areas or related ones that provides credibility and an ability to respond rapidly to government and private sector needs. The new areas offer a broad range of funding opportunities within government, industry and university sectors.

The Decision Support initiative, termed InfoDec: Information Comprehension for Decision Support, assists experts in decision-making based on data acquired from a variety of sources, including sensors, satellites, databases, the Internet and private intranets. IMSC

researchers view the decision-making process as the three phases of information filtering and analysis, information integration and information presentation.

The Collaborative Systems initiative, termed ACE: Aware Collaborative Environments, focuses on a high-quality telecollaboration experience employing multichannel audio, high-definition video, multi-point streaming over IP networks, and natural multimodal

sensing and system awareness to facilitate effective human interaction and automatic operator-free system behavior. IMSC investigators seek to overcome barriers imposed by physical location and language through high-presence and automated task assistance.

The Serious Games initiative develops technologies for advancing games for serious application domains,

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### IMSC demonstrates first live Internet immersive environment

IMSC researchers demonstrated the first-ever live immersive environment over the Internet for a performance by the Miró Quartet, a nationally-known chamber music group, at the annual member meeting of the Internet 2 organization at the University of Texas (UT), Austin, in September.

"We were tremendously excited to

work with the Internet 2 organization and the Miró Quartet to demonstrate some of IMSC's latest technologies," according to IMSC Director Prof. Ulrich Neumann.

He pointed out that IMSC has developed award-winning applications in pre-recorded and streamed immersive

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**MIRÓ QUARTET LIVE OVER THE INTERNET**—Each member of the Miró Quartet appeared on a separate screen (above) as IMSC researchers transmitted their live performance to a second auditorium to demonstrate the first-ever live Internet immersive environment at an Internet 2 organization meeting in September.

# IMSC & ISI launch GamePipe Laboratory

IMSC and the Information Sciences Institute (ISI) in the Viterbi School of Engineering have launched the GamePipe Laboratory as a joint venture to create a digital game production capability at USC.



**Dr. Michael Zyda**

“GamePipe will be a key part of IMSC’s new Serious Games development initiative,” according to IMSC Director Ulrich Neumann.

“We are very excited about working with ISI to

make USC an international center in education, research and development of Serious Games,” he said.

As a working definition, Serious Games is defined as enabling a mental contest, according to certain rules, played with a computer, that employs entertainment to further governmental and corporate training, education, health, public policy and strategic communication.

Dr. Michael Zyda, an established leader in the Serious Games area, will be the Director of the GamePipe Lab and an Associate Director of IMSC.

Dr. Zyda, the former Director of the MOVES Institute at the Naval Postgraduate School in Monterey, CA, developed the multiple award winning online game, “America’s Army Operations,” to build the Army’s recruitment efforts.

Dr. Zyda will work closely with IMSC key investigator Prof. Chris Kyriakakis and Joseph Sullivan, Manager of Strategic Development at ISI, who are leading game research for their respective organizations.

Prof. Kyriakakis emphasized that IMSC’s new interdisciplinary games research effort will collaborate closely with the GamePipe Lab and focus on advancing Serious Games by leveraging unique IMSC research, innovative content creation, and design.

The GamePipe Lab, which will

open this month, will focus on four key areas:

—Infrastructure. The next generation of game software and hardware, including game engines and tools, streaming media, next generation consoles, and wireless and mobile platforms. New techniques will be investigated for massively multiplayer online games.

—Cognition and Gaming. Developing theories for modeling and simulating computer characters and story to display realistic emotions. Finding ways to analyze large scale game play. Creating ways to use games

for teaching by integrating pedagogy and story.

—Immersion. Creating technologies to engage the mind through graphics, sound and haptics (touch). Building new forms of user interfaces. Developing a theoretical framework for how gamer engagement works, and how greater “presence” can be achieved.

—Serious Games. Basic research on the role played by interactive media and games in education, training, human performance engineering and testing. Finding new applications of games to issues of health, policy and communication, and developing such games.

## IMSC Games research showcased

At a USC Games Summit in October, IMSC researchers described IMSC’s multidisciplinary collaboration in digital game development and stressed the importance of such a multidisciplinary approach. Researchers from eight USC Schools and other organizations participated in the two-day event. Gordon Bing, Executive Vice President and Chief Creative Officer of Electronic Arts, a major computer game producer, gave the keynote speech and served as industry advisor at the summit.

Prof. Wee Ling Wong discussed the latest developments in IMSC’s 2020 Classroom project, which is creating the Metalloman immersive environment for a model for the classroom of the future. Metalloman comes from an imaginary world existing 30,000 years into the future where humans have merged with machines. Users learn

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*Students engaged in various IMSC games.*

# Audyssey Labs introduces breakthrough technology

Audyssey Laboratories, Inc., of Los Angeles, an IMSC spin-off company, has introduced breakthrough technology for home theater systems that customizes the listening experience for each person in the room.

The technology, called MultEQ™, is a feature of the AVR-5805, a new audio/video receiver from Denon Electronics of Japan, a leading manufacturer of high-quality home theater receivers.

Denon introduced the receiver at the Custom Electronics Design and Installation Association (CEDIA) Exposition in Indianapolis, IN, in September.

“Audyssey’s MultEQ™ technology turns every seat into the ‘best seat in the house,’ breaking through today’s ‘sweet spot’ limitation, where only one seat gets the best sound,” according to IMSC key investigator Prof. Chris Kyriakakis, an Audyssey Co-founder and Chief Technology Officer.

“Now, with MultEQ™, the entire audience is in the ‘sweet spot’—everyone can hear the same high-quality sound, no matter where they are sitting in the room,” he said.

Denon said the AVR-5805 receiver is an unprecedented single-component solution that lets consumers enjoy a distributed four-zone home theater entertainment experience.

Prof. Kyriakakis, an associate professor of electrical engineering and IMSC’s Research Area Director for Sensory Interfaces, said MultEQ™ is the first room correction and calibration technology capable of minimizing the effects of room acoustics for multiple listeners.

He said that an Auto Set-Up function automatically determines how many loudspeakers are connected, whether they are connected in phase, and whether they are satellites or subwoofers. It then analyzes and calibrates speaker level size and distance.

In addition, he said, MultEQ™ detects the proper crossover point and determines the correct frequency response for up to eight listener positions simulta-



**Prof. Chris Kyriakakis**

neously. It creates an optimized soundfield and compensates for speaker and room capabilities.

Prof. Kyriakakis pointed out the

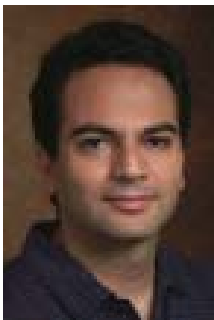
MultEQ™ technology resulted from research in audio signal processing, acoustics, and psychoacoustics at IMSC’s Immersive Audio Laboratory.

Prof. Kyriakakis also said MultEQ™ is available for car audio systems.

Denon said the receiver is the first-ever high-performance alternative to multi-component distributed audio-visual systems. The AVR-5805 offers such setup and operating options as one full 9.1-channel surround sound system in a single room; two discrete 5.1-channel systems in different rooms; one 7.1-channel system in the main zone, with a 2.1-channel system in a second room and a mono system in a third room; and an audiophile-oriented “bi-amp” mode, with two amplifiers used for each front, left, right and center

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## Prof. Shahabi receives Presidential award



**Prof. Cyrus Shahabi**

Prof. Cyrus Shahabi, IMSC’s Research Area Director for Information Management, received the prestigious 2003 Presidential Early Career Award in a White House ceremony in mid-September.

Prof. Shahabi, an associate professor of computer science, received the award for his pioneering research into the management of streams of sensor data created as humans interact with virtual reality environments.

He was among only 20 out of 400 recipients (or five percent) of the National Science Foundation’s annual Early Career Award to receive this additional award.

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## Prof. Chew named to IMSC post



**Prof. Elaine Chew**

Prof. Elaine Chew, a key IMSC investigator, has been named IMSC’s Research Area Director for Human-Centered Sciences, succeeding Prof. Skip Rizzo, who has recently joined USC’s Institute for Creative Technologies (ICT).

“I am honored to be offered this position, and I look forward to serving the Center in this new capacity,” she said. “Prof. Rizzo’s energy and passion for his work and practical experience in clinical psychology have left a unique and indelible mark in human factors at IMSC. His shoes will be hard to fill.”

Prof. Rizzo will continue to work collaboratively  
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## Tech Spotlight

A special feature on IMSC projects

# IMSC developing novel translation system

IMSC key investigator Prof. Shri Narayanan and his team are developing a novel language translation system that allows English-speaking doctors to communicate with Persian-speaking patients about their medical concerns.



**Prof. Shri Narayanan**

professor of electrical engineering, computer science and linguistics who heads the Speech Analysis and Interpretation Laboratory (SAIL).

“Presently, most automatic translators are restrictive in the sense that people can speak only a fixed set of phrases,” he said. “But our system allows for natural two-way dialog between people speaking two different languages.”

The system, called the Transonics Spoken Dialog Translator, is being developed for the Defense Advanced Research Projects Agency (DARPA).

Prof. Narayanan said the system is in its first stages of development, but has already provided a compelling proof of concept. However, he pointed out, the creation of a truly context-aware translator that can be easily and rapidly ported to other domains and languages is an ongoing research quest.

Teams at other university and industry sites are building medical translation systems for Mandarin Chinese, Pashto and Thai for the DARPA project.

In using the laptop-based system, the doctor and patient each wear a headset with microphones and ear-

phones. “Our system uses new technology to allow real-time spoken language communication between health professionals and patients,” according to Prof. Narayanan, an associate

phones. The doctor asks a question in English, and the computer translates on the fly with the patient hearing the question in Persian. When the patient answers in Persian, the computer translates the response into English immediately. They hear their questions and answers via a computer-generated voice.

Prof. Narayanan pointed out that the system has been evaluated for basic usability by English-speaking doctors and nurses with Persian speakers acting as patients. “Informal results indicate that participants can sometimes communicate quite effectively using our system,” he said.

The system uses a number of cutting-edge technologies, including computer speech recognition, bi-directional language translation, dialog tracking and speech synthesis, according to Dr. Panayiotis Georgiou, research faculty in electrical engineering from IMSC and an investigator on the project.

Dr. Georgiou also said the development of the system involves extensive

data collection, including collection of a corpus of interactions between USC medical students and actors portraying patients with different ailments.

The Transonics team is a partnership between USC and industry collaborator HRL Laboratories. USC team members, in addition to Prof. Narayanan and Dr. Georgiou, include Dr. Kevin Knight and Dr. Daniel Marcu, research faculty in computer science from USC’s Information Sciences Institute, and Dr. David Traum, research faculty in computer science from USC’s Institute for Creative Technologies.

Key HRL investigators include USC alumni Dr. Robert Belvin and Howard Neely, and Cheryl Hein. Ph.D. students in electrical engineering and computer science who have made key contributions include Emil Ettellaie, Dagen Wang, Sudeep Ghande, Ananthakrishnan Shankar and Murtaza Bulut. The project’s Web site at <http://sail.usc.edu/transonics> features more details and a video.



**NOVEL TRANSLATION SYSTEM**—IMSC researchers are building a translation system for English-speaking doctors to communicate with Persian-speaking patients.

## Tech Spotlight

### A special feature on IMSC projects

# Researchers create Augmented Virtual Environments

IMSC researchers are developing new digital video technology that moves beyond today's two-dimensional video to create dramatically realistic 3D "virtual environments," valuable especially in the areas of homeland security and military operations.

Prof. Ulrich Neumann, IMSC Director and key investigator in computer graphics, and Prof. Suya You, Research Assistant Professor, and their team are combining 2D video with 3D modeling to create what is termed Augmented Virtual Environments (AVEs).

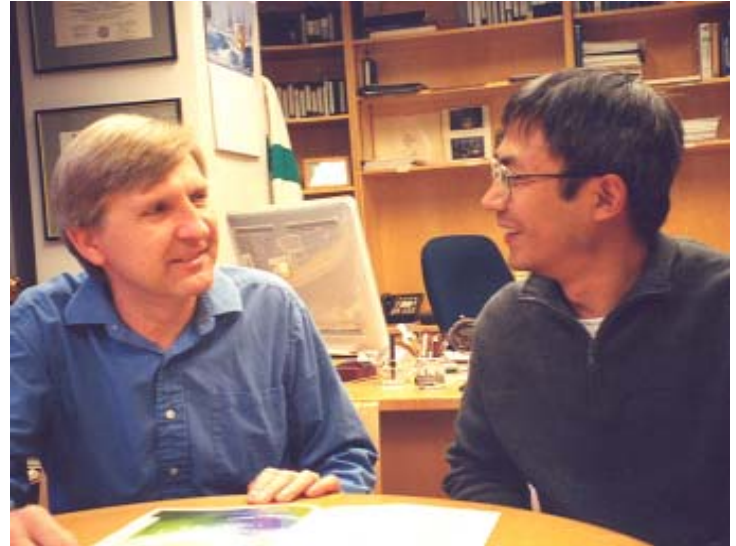
The AVE system could be used to improve today's airport crowd monitoring systems, for example. Security personnel would be able to view the progress of a passenger from arbitrary points of view in a single monitor, rather than having to follow the passenger as he or she passes through several monitors. The video streams from various cameras are combined to give a complete 3D view in one monitor.

To develop this AVE 3D view, the (real) 2D video streams are projected on to a (virtual) 3D model of the scene—creating the augmented virtual environment (AVE) view. The AVE 3D model with fused video streams is especially useful in tactical, decision-making, or operations scenarios where both high-level and detailed views of a scene are important.

Prof. Neumann pointed out that 3D models alone only represent a snapshot of the scene with static buildings, terrain and vegetation. In comparison, he said, the AVE system augments static models with video of the real-time or recorded dynamic activities occurring in a corresponding real-world scene.



*An Augmented Virtual Environment (AVE) image showing three video projections as red wire-frames around a USC campus building complex.*



*IMSC Director Ulrich Neumann (left) and Prof. Suya You, Research Assistant Professor, discuss the Augmented Virtual Environments (AVE) project.*

"In fusing dynamic imagery with 3D models, we provide a unique approach to visualizing spatial relationships and temporal events that occur in real-world environments. We create a model of the real world and its activities to provide users with a god's-eye view," Prof. Neumann said.

The main components of the AVE system are:

- Rapid production of accurate static 3D surface models from aerial (or ground) laser scans.
- Sensor tracking and calibration to ensure accurate image and model registration for data fusion.
- Moving object detection and tracking to facilitate the 3D modeling and incorporation of dynamic scene elements.
- An integrated system for video acquisition and view control based on industry standards and interfaces.

An AVE demonstration system has been developed for Northrop Grumman for demonstrations of video stream visualization for security applications. An AVE model of the USC campus is being used for visualizing simulations developed by Prof. Milind Tambe, a researcher in the USC Center for Risk and Economic Analysis of Terrorism Events (CREATE), which was established by the U.S. Department of Homeland Security (see <http://www.usc.edu/dept/create/index.php/index.php>).

In addition, AVE applications for training and after-action reviews are being pursued in collaboration with the USC Institute for Creative Technologies (<http://www.ict.usc.edu>).

For information on the USC AVE system, visit <http://imsc.usc.edu/research/project/virtcamp>.

## Internet leaders speak at IMSC Open House

Internet pioneer Vinton Cerf and Hispanic Internet business leader Roberto Medrano gave presentations at IMSC's Open House in October.

Cerf, who is a co-designer of the TCP/IP protocols and the architecture of the Internet, viewed the Open House demonstrations and met with IMSC faculty.

In his keynote talk after touring IMSC, he praised IMSC's demonstrations, citing "exciting opportunities for user interaction in immersion and special effects."

He spoke enthusiastically about the "evolution of multimedia into the Internet environment." Cerf is MCI's Senior Vice President of Technology Strategy.

In his presentation, Medrano emphasized the importance of improving opportunities for Hispanic entrepreneurs in the high tech field.

He is a co-founder and Chief Executive Officer of HispanicNet, a non-profit organization dedicated to assisting Hispanics in high tech businesses.

Medrano is also Executive Vice President of Sales and Marketing for Digital Evolution, an enterprise class software vendor for service-oriented architecture security



Vinton Cerf



Roberto Medrano

and management.

The Center for Technology Commercialization in the USC Marshall School of Business and HispanicNet joined with IMSC to co-sponsor the evening with Cerf and Medrano. Members of HispanicNet attended the event.

## IMSC's live immersive event features Miró Quartet . . .

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environments. While the quartet performed for one audience, researchers transmitted their performance in real time to a second audience in another auditorium, using advanced video and audio technologies for an unprecedented sense of immersion.

The images of the performers were projected on four high-definition screens (one for each performer), and the audio was captured and rendered using IMSC's 10.2-channel Immersive Audio technology, the next generation beyond 5.1-channel surround sound.

At intermission, the two audiences switched places, and each group experienced a live version and an immersive version. The two groups were surveyed afterward, and both thought the immersive environment was an engaging representation of the live performance.

IMSC participants in the project included Chris Kyriakakis, Director of the IMSC Immersive Audio Laboratory; Tomlinson Holman, key investigator at the Immersive Audio Lab, Professor of Film Sound at the USC School of Cinema-Television, and principal with TMH Corp.; Roger Zimmermann, IMSC streaming media technology specialist and Research Assistant Professor; Christos Papadopoulos, Assistant Professor of Computer

Science; Alexander A. Sawchuk, IMSC Deputy Director and Professor of Electrical Engineering; Elaine Chew, Assistant Professor, Epstein Department of Industrial and Systems Engineering; James Donahue, consultant to IMSC and Principal Recording Engineer, WGBH, Boston; Beomjoo Seo, IMSC graduate research assistant; and Moses Pawar, IMSC graduate research assistant.

Internet 2 is a consortium being led by more than 200 universities working in a partnership with industry and government to develop and deploy advanced network applications and technologies, accelerating the creation of tomorrow's Internet.

Go to <http://www.miroquartet.com> for more information on the Miró Quartet.

For more information on IMSC Internet streaming technologies, visit <http://dmrl.usc.edu/hydra> and <http://imsc.usc.edu/research/project/immersiveaudio>.

### IMSC News

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Viterbi School of Engineering  
University of Southern California

Ulrich Neumann, Director  
Rick Keir, IMSC News Editor and  
Communications Manager

© 2005 Integrated Media Systems Center  
University of Southern California  
3740 McClintock Ave., Suite 131  
Los Angeles, CA 90089-2561  
(213) 740-9813  
E-mail: [rkeir@imsc.usc.edu](mailto:rkeir@imsc.usc.edu)  
<http://imsc.usc.edu>

## IMSC Game projects showcased at USC Games Summit . . .

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biology by solving a crisis in this future world by traveling back in time to address biological issues. IMSC's 2020 Classroom project features 3D high-definition visuals, 10.2-channel Immersive Audio and a customized "immersidata" management system. Other IMSC researchers on the project team are Prof. Chris Kyriakakis, Prof. Cyrus Shahabi, Eduardo Carriazo, Tim Marsh and Luciano Nocera.

Victor LaCour, IMSC Creative Director, gave an overview of the necessity of multidisciplinary game development and spoke about some of his current game projects developed under IMSC's Interdisciplinary Initiative Program.

Some of the games and collaborators discussed were:

—Choyo, a mobile game for students to interact with a virtual 3D USC campus. Collaborators: USC School of Cinema-Television's Interactive Media Division and IMSC.

—MediaBase, a digital application to explore how different media, including video, film, music, speech, 3D objects in sculpture or architecture, photography and painting, can be used effectively in scholarly discourse. Collaborators: IMSC, Institute for Multimedia Literacy at USC and Emerson College.

—Sim-Finance, a multimedia game that demonstrates how a sequence of financially critical decisions and life events affect a user's economic situation over time. Collaborators: IMSC, USC Marshall School of Business and USC Credit Union.

—Russian Modernism Game; Immersive Expo 1889: A 3D gaming experience that immerses the user in 1889 Russia during the time of the World's Fair Expo. Collaborators include: USC Annenberg Center for Communication; Institute for Multimedia Literacy; and Russian scholars from USC, University of Chicago and Stanford University. IMSC is planning to use Panasonic curved plasma screens to create a total immersive panoramic movable experience inside the virtual expo.

LaCour also outlined a course he will give in the spring on team-based game development. "The class will be shaped around artistic and engineering talent and will teach students to work in a collaborative setting with students from various

disciplines," he said. He mentioned that IMSC, the USC Viterbi School of Engineering and other USC centers will be able to use this class as a way to approach research needs in gaming scenarios.

Prof. Roger Zimmermann presented on "Streaming Media Support in Online Gaming." He explained that streaming media will become increasingly important in the future for massive multiplayer online games. "For example, there will be more voice communication for collaborative groups of players," he said. "At the same time, very large scale games are presenting a very challenging environment where many research questions have to be addressed."

Prof. Zimmermann presented the AudioPeer project (<http://dmrl.usc.edu/research.html>), which is being developed in collaboration with the Viterbi School of Engineering's Distance Education Network to enable audio communication between participants in large-scale infrastructures through peer-to-peer streaming. He also described IMSC's high-quality streaming work supporting high-definition video and Immersive Audio.

Prof. Skip Rizzo, who recently joined USC's Institute for Creative Technologies (ICT) from IMSC, spoke on "Gaming for Health: Virtual Reality Game-Based Applications for Mental Disorders and Rehabilitation." At ICT, Prof. Rizzo is continuing his collaboration with IMSC investigators. He described the following projects:

—Attention process assessment of children with attention deficit hyperactivity disorder.

—Pain distraction for children undergoing painful medical procedures and chemotherapy.

—Exposure therapy for returning Iraq War veterans with post-traumatic stress disorder.

—Motor rehabilitation for persons with central nervous system dysfunction (i.e., stroke, brain injury).

He said that "the integration of game technology and experiences with virtual reality based approaches for clinical assessment, treatment and rehabilitation offers powerful options that could revolutionize standard practices in these fields." (<http://imsc.usc.edu/humanfactors>).

## Prof. Chew named to IMSC position . . .

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with IMSC researchers in his new position at ICT.

Prof. Chew brings expertise and experience in the human-centered sciences area through her work in music perception and cognition. Two of her projects are MuSA.RT (Music on the Spiral Array. Real Time), an interactive music visualization system, and ESP (Expression Synthesis Project), a driving interface for rendering expressive performances from deadpan MIDI files. Both systems were created using IMSC's Software Architecture for Immersipresence (SAI) in collaboration with Prof. Alexandre François. For IMSC's Distributed Immersive Performance (DIP) project, Prof. Chew is developing metrics for measuring the psychophysical and perceptual effects of musical interaction over distance to determine the thresholds

for usability and bottlenecks to improved human interaction in remote collaborative environments. DIP is developing a system to facilitate musicians performing together over the Internet.

Last year, Prof. Chew received a prestigious Early Career Award from the National Science Foundation's program in Human-Computer Interaction for her proposal entitled, "Performer-Centered Approaches to Computer-Assisted Music Making." She has been a key IMSC investigator since she joined the USC faculty in 2001 as an assistant professor of industrial and systems engineering.

She earned her Bachelor's degree in Mathematical and Computational Science and in Music from Stanford University and holds a Master's and Ph.D. in Operations Research from the Massachusetts Institute of Technology.

## Audyssey's breakthrough . . .

*(Continued from page 3)*

speaker or for a full five-channel system, delivering maximum power and performance.

Audyssey Laboratories was founded in July 2002 as an IMSC spin-off by Prof. Kyriakakis; USC Ph.D. and Audyssey President Dr. Sunil Bharitkar; and USC Master's graduate and Audyssey Chief Executive Officer Phillip Hilmes. USC Prof. Tomlinson Holman, a key IMSC investigator, also serves on the company's Board of Directors. More information about Audyssey is available at <http://www.audysseylabs.com>.

Dr. Isaac Maya, IMSC Director of Industry and Technology Transfer Programs, pointed out that Audyssey's commercial success with this technology is a direct result of a research culture that encourages close collaborations with industry.

"IMSC research is aligned with industry needs and offers higher potential for commercial success," Dr. Maya said, adding that eight other small companies have been spun off from the Center in addition to Audyssey. He also said that IMSC has successfully concluded more than 100 licenses and technology transfers, including some major commercial successes, and has a broad spectrum of advanced information technologies available for licensing.

For more information on IMSC's industry program, visit <http://imsc.usc.edu/industry>, or contact Dr. Maya at (213) 740-2592; [imaya@imsc.usc.edu](mailto:imaya@imsc.usc.edu).

## Director's Message . . .

*(Continued from page 1)*

combining the engagement of immersive imagery and sound; automated authoring tools to speed production; streaming of dynamic game content to distributed locations; enhanced interaction through multimodal user sensing, speech technologies, and emotive animation; and assessment of user behavior using database methods and human performance metrics.

As part of this initiative, IMSC has partnered with the Information Sciences Institute to launch the GamePipe Laboratory, which will focus on game production. (See article on page 2.)

IMSC has been working on game development in its 2020 Classroom and Sim-Finance projects, and these were presented at a USC Games Summit in October. (See article on page 2.)

## Shahabi receives award . . .

*(Continued from page 3)*

He is the first faculty member in the Computer Science Department to receive the Presidential Career award and the fifth in the USC Viterbi School of Engineering.

The award honors the most promising beginning researchers in the nation within their fields.

Fifty-seven scientists and engineers, nominated by eight federal agencies, received the award, formally titled the 2003 Presidential Early Career Award for Scientists and Engineers. (<http://infolab.usc.edu/News/pecase03.html>)

Integrated Media Systems Center  
University of Southern California  
3740 McClintock Ave., Suite 131  
Los Angeles, CA 90089-2561

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