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Director's Message

IMSC plans new Web site & industry initiatives

I am pleased to serve as interim IMSC Director during our nationwide search for a permanent Director. A Search Committee is already in place, and the position is posted on our Web site at <http://imsc.usc.edu>. We expect the new Director to be selected by early next year.

Regarding the Web site, we are redesigning the site to make it more informative and easier to navigate. We feel that IMSC's Web presence is very important, especially for overseas partners and collaborators. Rick Keir, IMSC's Communications Manager, is working with Mike Fanous, IMSC's Webmaster, and Thomas Pintaric, an IMSC student, to develop the new site.



Dr. Ulrich Neumann

Sue Lewis, IMSC's Executive Administrative Director, and I recently returned from a meeting with National Science Foundation (NSF) staff in Washington, D.C., where we discussed the NSF site visit last spring. Based on the excellent report and constructive suggestions, we are already actively preparing for the Year Six site visit. Our annual Investigators' Retreat is coming up at the end of September, and this will provide IMSC faculty and staff an opportunity for in-depth planning and coordination of the research program for the coming year and beyond.

I'm pleased to report the continued successes in our industry program. We welcome eight new industry partners—AboveNet, Airborne 1, DRS Technologies, Intervideo, Microsoft, NavTech, Prentice Hall Professional Technical

Reference and Time Domain (which is rejoining after a short absence). You can find information about their work with IMSC on p. 3. To increase the range of interactions with our partners, we are developing initiatives that will provide partners with increased accessibility to IMSC's intellectual property. A detailed briefing of the new options will

be presented to the Scientific Advisory Board members at the November 15 meeting.

With the start of the fall semester, we welcome about 20 new IMSC students, and we are pleased to continue the Undergraduate Research Program for its third year with funding for about *(Please turn to page 8)*

Dr. Neumann has overseen Sensory Interfaces research since IMSC's inception in 1996

Dr. Ulrich Neumann, who was named Director of IMSC on an interim basis on July 1, has overseen IMSC's Sensory Interfaces research since the Center's inception five years ago.

An Associate Professor of Computer Science, Dr. Neumann conducts research into interactive media, 3D computer graphics and immersive environments. He directs the Computer Graphics and Immersive Technologies Laboratory at USC.

Dr. Neumann earned a Master of Science in Electrical Engineering at the State University of New York at Buffalo in 1980 and completed a Ph.D. in Computer Science at the University of North Carolina at Chapel Hill in 1993, *(Please turn to page 8)*

IMSC demonstrates advanced digital video & audio streaming

IMSC recently brought on-demand business training and home entertainment one step closer to the "being there" experience.

Over the summer, IMSC teamed with industry partner AboveNet (a subsidiary of MetroMedia Fiber Networks) to demonstrate some of the world's most advanced streaming of digital video and audio content from digital storage over a real-world shared Internet connection.

The streaming experiment resulted in video of digital cinema quality and audio of higher quality than ever before

demonstrated over the commercial Internet, raising the realism level that can be achieved in the home or office.

Such progress is a boon for the consumer and the future of the home theater experience. "This is a major step toward making the home or office feel like the Cineplex. And, with audio that surpasses even the current high quality standards of 5.1 channel surround sound, future systems may be able to replicate the feel and sound of a performance in a music hall," according to Dr. Isaac Maya, IMSC's Director of *(Please turn to page 7)*

New SAB Chairman impressed by IMSC's progress

Dr. James Baker, IMSC's new Scientific Advisory Board (SAB) Chairman, has seen the Center grow from its founding five years ago as a National Science Foundation (NSF) Engineering Research Center.

He is the President and Chief Executive Office of FX Palo Alto Laboratory, which is responsible for research in software and information science in support of Fuji Xerox, Ltd., of Japan.



Dr. James Baker

"I've really been quite impressed by IMSC's progress in multimedia," he said. He praised the development of the Media Immersion Environment (MIE), the Center's software and hardware infrastructure that supports IMSC projects. The MIE has been designed as a national testbed for multimedia research.

"It is striking that IMSC has been able to marshal such an active group of investigators over the years," Dr. Baker said. "At the same time, the Center has

been able to broaden the spectrum, including research, technology transfer, startups, community outreach in re-training laid-off engineers and many other activities."

He lauded the cross-disciplinary nature of IMSC initiatives, involving not only Electrical Engineering and Computer Science, but also Biomedical Engineering, Communication, Journalism, Cinema-Television, Gerontology, Music and Fine Arts, among others.

Dr. Baker has more than 25 years of experience in the research, development and commercialization of software-related technologies, and has formed software research organizations in three corporations. He was educated in mathematics and received a Bachelor of Arts and a Master of Arts from the University of Texas and a Ph.D. from Iowa State University.

He has authored a number of publications in the areas of mathematics, computer science, systems science and software technology, and currently serves on the advisory boards of several universities.

FX Palo Alto Laboratory has been a strong IMSC industry partner over the years. Dr. Baker has been active on both the SAB and IMSC's Board of

Councillors (BOC). The SAB, which is composed of representatives of IMSC's industry partners, provides feedback and suggestions on IMSC programs, and the BOC, which is composed of high-level executives in the multimedia field, offers long-term strategic guidance to the Center.

Dr. Baker took over as SAB Chairman at the spring meeting of the Board in May, replacing Dr. Andrew G. Tescher, Principal Scientist for Compression Science Corporation of Campbell, CA. Dr. Tescher continues to serve on the SAB, and both Dr. Baker and Dr. Tescher continue as members of the BOC. Dr. Baker complimented Dr. Tescher for his leadership of the SAB and thanked him for his service. He also commended Dr. Max Nikias for his leadership as IMSC Director. Dr. Nikias became USC's Dean of Engineering on July 1.

Dr. Baker said he is interested in the SAB incorporating three important issues in its normal review process:

- Maintaining the Center on an even keel during the present transition period between permanent Directors,
- Keeping IMSC industry partners involved with the Center during this

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IMSC releases software architecture for multimedia

IMSC recently released a generic software architecture that addresses multimedia application development.

The Modular Flow Scheduling Middleware (MFSM) package is available as open source code on SourceForge.net, a major Web site for open source releases. The address is mfsm.sourceforge.net.

The MFSM package is being released under the terms of the GNU Lesser General Public License as published by the Free Software Foundation.

The package was developed by Dr. Alexandre R.J. François, an IMSC Research Associate, as a key component of IMSC's Media Immersion Environment (MIE), the Center's hardware and software framework for multimedia development. The MIE has been created by IMSC as a national testbed for multimedia technologies.

Dr. François said that a major benefit for the distribution of the source code on the Web is that any other developer can contribute to the core. "The MFSM is complex in design, but simple to use, so that users will not have to worry about the

complexity of the underlying system. Instead, they can focus on their own requirements and their own work," he said.

Dr. François said that with this package developers will be able to work in a consistent environment with code already written to handle certain functions. "For example, if the program requires live input from a camera, the developer does not have to rewrite video capture code because that has already been done. There is an existing module for it. The same goes for displaying video on the screen," he said.

The package includes a Flow Scheduling Framework Library, an Image Toolkit Library, a Graphics Toolkit Library, a Windows Toolkit Library, an Intel® Open Computer Vision Library encapsulation and a Demonstration Application, which captures video and displays it on the screen.

The Flow Scheduling Framework Library is an extensible set of classes that provides basic synchronization functionality and composition mechanisms to develop data-stream processing components. It specifies and implements a common generic

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New partners enrich IMSC's industry relations program

Eight new industry partners have joined IMSC in the past few months, according to Dr. Isaac Maya, IMSC's Director of Industry and Technology Transfer Programs.

"It's very reassuring that companies perceive a high value in participating in our industry program, even in these difficult times," Dr. Maya said. "In response to increased company needs for new ideas and markets, we have stepped up our industry relations efforts so that we can continue to meet and then exceed the expectations of our partners."

The new partners are AboveNet, Airborne 1, DRS Technologies, Intervideo, Microsoft, NavTech, Prentice Hall Professional Technical Reference (PTR) and Time Domain (which is rejoining after a short absence).

The partners contribute to IMSC in the following specific ways:

AboveNet—Provides co-location space at its El Segundo facility, where IMSC has located four Yima™ nodes. The

(Please turn to page 7)

Students collaborate on art & technology exhibit

In a unique cross-disciplinary endeavor, Doug Fidaleo, an IMSC Ph.D. student who specializes in IMSC facial-expression recognition technology, and



IMSC Ph.D. student Doug Fidaleo (left) and Brian Cooper, a Master's student in the School of Fine Arts, discuss the construction of their exhibit, "Comfort Control," in Cooper's studio. Fidaleo tries out the easy chair and headgear that are being prepared for the exhibit. Cooper painted the easy chair in the background.

Brian Cooper, a Master's student in the School of Fine Arts who specializes in painting, have teamed up to create a participatory exhibit combining art with technology.

The exhibit, "Comfort Control," which uses the IMSC facial-expression recognition technology to explore the relationship of psychological comfort to uncomfortable situations, will be open from 9 a.m. to 5 p.m., September 24-30, in the Watt Hall Ground Floor of USC's Helen Lindhurst Fine Arts Gallery. Admission is free.

Participants will be presented with various situations evoking different facial expressions in a game-like process as they sit in a big easy chair in a specially-designed living room atmosphere. They will be prompted with stimuli to evoke such emotions as happiness, sadness, anger, disgust and fear. A game-like phase will be like part amusement park ride and part video.

Fidaleo and Cooper developed the collaboration after they were introduced by Ann Page, an Adjunct Lecturer in the School of Fine Arts and an advisor to graduate students in the School. She was co-teaching an Art and Technology course and met Fidaleo through class visits to his IMSC laboratory.

She said that she and co-teacher Marcus Thieboux, a Programmer Analyst at the School of Engineering's Information Sciences Institute, talked with Fidaleo about possible ways of using the facial-expression technology in some form of art exhibit.

She was already familiar with Cooper's art work and introduced the two students because she felt they could work together successfully on a collaborative project.

Ms. Page pointed out that the resulting exhibit, "Comfort Control," is an attempt to demonstrate "the potential for the interface between art and technology as a creative interaction between programming for scientific study and visualizing artistic, philosophical and psychological ideas."

She also said that "Comfort Control" is designed to offer some surprises to those who settle down in the cozy easy chair and that participants just "might find out some things about themselves that they didn't know."

IMSC's technology makes choosing glasses easy

For people who wear glasses, the job of choosing a new pair could soon become a lot easier because of innovative IMSC technology licensed and developed by industry partner Geometrix and then offered as a commercial product through its channel partner Visionix.

Geometrix of San Jose licensed IMSC's 3D face modeling technology about a year and a half ago and used it to create a high-speed 3D face capture solution, FaceVision™, and a virtual try-on solution for the retail optical market. Geometrix developed a complete suite of automated 3D face capture and virtual try-on technologies that realistically simulate all geometric and visual aspects of wearing eyeglasses. With these technologies, Visionix of Israel has recently introduced 3D iView, the first commercial 3D virtual try-on system for eyewear.

"With the use of FaceVision™, we were able to offer the eyewear industry the first 3D Face Capture and Try-On System," said Arthur Zwern, President of Geometrix.

"We anticipate that customers will soon be able to enter a retail optical store, sit down in front of a 3D iView station and have their picture taken. Once the 3D face image is captured, customers can then either sit at a 3D iView station or at their home PC to select and try on eyewear. We have revolutionized how customers will select lenses and frames in the future," he said

Eyewear firms evaluating 3D iView

3D iView is now undergoing extensive market evaluation by some of the world's largest eyewear companies. "This is a

great example of how IMSC technology moves from a laboratory technology to a commercial product," according to Dr. Isaac Maya, IMSC's Director of Industry and Technology Transfer Programs.

Here's how 3D iView works:

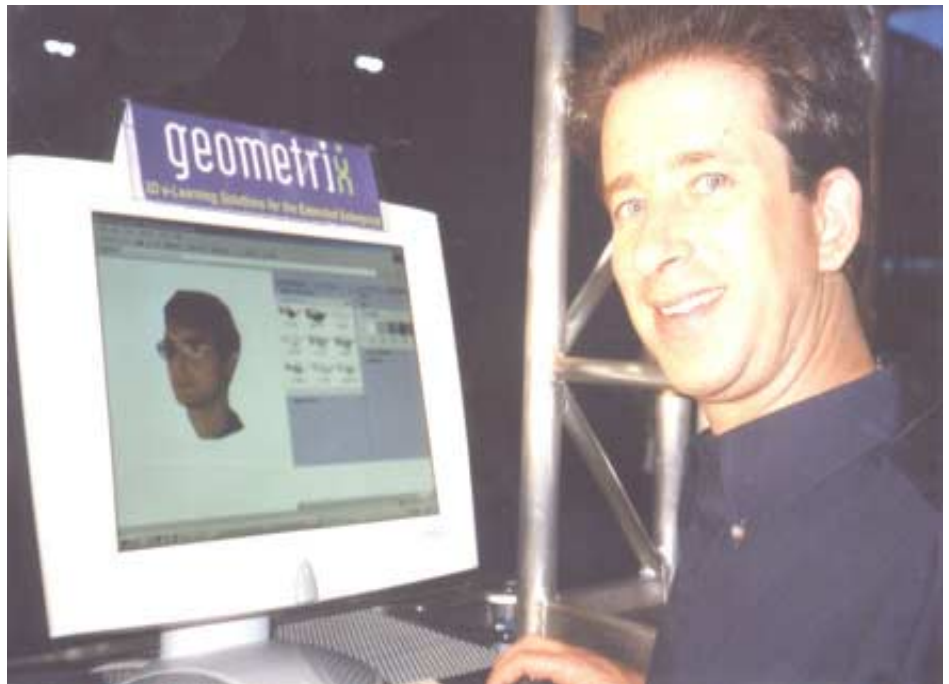
You take off your glasses and pose for a picture—really, a group of photos taken by six cameras at different angles at the same time. After only a minute and a half of digital processing, the six photos are turned into a 3D model of your face. With your glasses back on, you view your 3D model on a computer screen, along with a wide selection of frames with lenses. You place different glasses on your model on the monitor, seeing how the various frames and lenses would look on you. You can move the model and the glasses, getting many different views.

Suddenly, finding just the right glasses is much easier

Suddenly, the task of finding new glasses has become so much easier: Before 3D iView, you couldn't clearly see how you looked with the new frames because you had to take off your old glasses to try on the new—and empty—frames and then look in the mirror.

But now you can keep your old glasses on and readily see how you look with the new glasses, including both the lenses and the frame. And you can "try on" the glasses a lot faster, surfing through the computer's database, rather than hunting along the usual "wall" of frames at the store. Also, once your face model is created at the store, you can shop from home,

(Continued on next page)



FROM IMSC'S LAB TO COMMERCIAL PRODUCT—IMSC key investigator Dr. Gérard Medioni (left) developed IMSC's 3D face modeling technology that was then licensed and refined into a virtual try-on system for eyeglasses by IMSC partner Geometrix as shown by Arthur Zwern, Geometrix's President.



Choosing glasses made easy . . .

(Continued from previous page)

using the system through the store's Web site.

Geometrix reported that 40 million people who wear glasses do not see well enough in the mirror to remove their glasses and try on new eyewear designs, and that the \$16 billion eyewear industry considers the problem a major barrier to increasing sales.

The IMSC face modeling software used by Geometrix was developed by IMSC key investigator Prof. Gérard Medioni with assistance from Dr. George Chen, a former IMSC student. Dr. Chen received his Ph.D. in December 1999 and now works for ST Microelectronics, another IMSC partner.

Prof. Medioni began consulting for Geometrix in November 1999, and, in June 2000, took a sabbatical to serve as Chief Technical Officer of the company until this past May. He still consults for the company. He became Chairman of USC's Computer Science Department in July. Dr. Chen also assisted Geometrix, working for a month at the company's office to refine the technology.

3D iView making a splash in the industry

3D iView, with the refined FaceVision™ technology, is making a splash in the industry, according to Dr. Medioni. He said that "people were blown away" when IMSC's early technology was first demonstrated at SIGGRAPH 2000 in New Orleans.

"There must have been about 15 exhibitors doing face capture, and none of them could do what we did—just put the face model file on a diskette as it was and give it to the attendee right then. They all said that they had to touch it up first and send it out later," Dr. Medioni said.

3D iView, using FaceVision™, combines the usual two approaches to 3D face capture—scanner-based and model-based. Even though laser scanners and other hardware devices provide high accuracy 3D face capture, these systems come with a high hardware cost of thousands of dollars. Model-based systems in general simply wrap a 2D face image over a fixed 3D avatar mesh or require the user to push and pull many facial points to adjust the shape of a stored model to fit the

actual face. But 3D iView is the first to combine the single-click ease-of-use and shape fidelity of scanner-based approaches with the cost-effectiveness of model-based approaches.

The key to the success of 3D iView lies in Dr. Medioni's original vision: To develop what's called "a software solution"—one that relies fundamentally on software, without the need for special hardware.

To realize that vision, Dr. Medioni decided to rely only on regular cameras, rather than special and costly hardware, and to develop software to shoulder burdens previously assigned to hardware.

In 1992, Dr. Medioni started to develop a theory to support the approach. "I looked at making 3D models from 2D photos. We all have two eyes, so the idea was to use two images to create a 3D model," he said.

Need for 3D face models arose

At first, Dr. Medioni concentrated on developing models of objects, rather than faces. But then, he said, the unexpected occurred, as is common in the process of scientific discovery—the need for 3D face models arose. With the launch of IMSC in 1996, a vision was laid out of the eventual transmission of 3D human representations, or avatars, over the Internet for immersive environments.

Suddenly, researchers felt compelled not only to continue tackling the significant bottleneck of 3D content development on the Internet, but to shift from objects to faces to help in the construction of avatars as part of a broader, integrated vision. And, Dr. Medioni said, he resolved to avoid relying on the conventional practice of working with special hardware for face capture; instead, he wanted to use the common camera.

"That was the scientific quest. No one had ever dared to try to create a 3D face model with a plain old camera. They all used special devices," he said.

Dr. Chen developed software shortcuts to make the process work for a large class of objects.

"Before we knew it, we had a system robust enough to create a face model using two uncalibrated cameras in about 15 minutes," Dr. Medioni said.

One of the first of these 3D face models, that of IMSC's Director, was displayed for the members of the National Science Foundation site visit review team during their annual visit in 1999.

"Then, we asked ourselves: 'What can we do with it now?'" according to Dr. Medioni.

He found an answer in Geometrix, which, at the time, was working on 3D models of objects and general scenes.

Geometrix's Zwern recounted that he was very impressed by the potential of IMSC's face modeling technology and initiated discussions to license it and develop applications. As a result, Geometrix licensed the technology, following the common process in university-to-industry technology transfer of developing it into the so-called "industrial strength" technology of FaceVision™.

(Continued on next page)

IMSC's Cyprus Student Fellowship Program starts

The first two students in IMSC's new fellowship program for Cyprus students enrolled for the fall semester at USC.

Vesile Evrim, from the Turkish Cypriot community, and Charalambos Poullis, from the Greek Cypriot community, are both pursuing the IMSC-developed degree, the Master of Science in Computer Science with a specialization in Multimedia and Creative Technologies.

Under the fellowship program, they will be spending two years on campus, pursuing the degree. They will also collaborate on a research project of interest to Cyprus.

"It will be very good to study together in this program to show that there is no problem with students from the two sides working together," Evrim said.

Poullis added that the field of information technology (IT) is evolving in Cyprus and the fellowship program offers a "big chance to do something new. We can put aside our political differences and find something in common—and that thing in common is IT. IMSC is giving us a chance to prove that."

Evrim comes from Lefke, and just this summer received a Master of Science in Applied Mathematics and Computer Science from Eastern



IMSC students Vesile Evrim (left) and Charalambos Poullis from Cyprus.

Mediterranean University. She had previously earned her Bachelor of Science in the same field from Eastern Mediterranean. She plays piano on a professional level and enjoys swimming.

Poullis' home is in Nicosia, and he just finished his undergraduate work at the University of Manchester in England,

where he spent three years earning a Bachelor of Science in Computer and Information Systems. He is a scuba diver and plays guitar.

They both believe that the growth of IT will be important for their two communities. The fellowship program is funded by a federal grant.

Try-on system for eyeglasses . . .

(Continued from previous page)

Zwern pointed out that the relationship between Geometrix and IMSC has been the smoothest experience he has had in working with any university. "We already had a good team of technologists in place at Geometrix who knew the general technology, so that helped move things along," he said.

In developing FaceVision™, Geometrix added four more cameras to provide "ear-to-ear" coverage for the 3D model. Geometrix also developed a two-camera system for simpler applications, such as arcade game character personalization. A single-camera system is also being developed that will automatically create a large number of virtual cameras by tracking the user's head as the user turns left and right in front of the camera, thus achieving ear-to-ear coverage. The single-camera version is being created for mass-market applications that rely on hardware available on typical high-end home computers. Dr. Medioni's recent work for Geometrix has included assistance in developing this single-camera version.

For the virtual eyewear try-on application, Zwern next brought on board Visionix as a channel partner, which introduced 3D iView with the FaceVision™ technologies. Visionix develops, manufactures and distributes innovative instruments for the measurement of optical lenses and contact lenses for opticians, ophthalmologists and laboratories and provides an important channel for manufacturing, sales and distribution. With 3D iView presenting a cost-effective solution to a recognized problem, Dr. Medioni pointed out that IMSC's strategic approach to technology development and transfer was a key factor in successfully moving promising technology from the laboratory to the marketplace.

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New industry partners . . .

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company has provided IMSC with streaming capability of up to 100 megabits per second.

Airborne 1—Collaborates with IMSC in conducting an airborne laser terrain mapping demonstration, including all airborne and ground survey operations.

DRS Technologies—Supports work in Quality of Service protocols and fault-tolerant video compression over IP (Internet protocol) networks.

Intervideo—IMSC is evaluating performance improvements of the company's video codecs.

Microsoft—Provided funding to support research in IMSC's Sensory Interfaces research area.

NavTech—Has provided highly detailed map data sets of various regions around the globe for use in spatial information integration research.

Prentice Hall PTR—Developing a Yima™ streaming media server software demonstration version to accompany the upcoming

book "Streaming Media Server Design," which will be published by IMSC Press, a partnership of IMSC and Prentice Hall PTR.

Time Domain—Provided equipment for the Ultrawideband Radio Laboratory (UltraLab).

As do all IMSC partners, these companies now have access to the Center's state-of-the-art, cutting-edge research, technology applications and testbeds. Partners interact with IMSC's leading researchers who are intimately familiar with the relevant technology and who can provide feedback and comments on company applications.

They have the opportunity to network and interact with complementary companies in an environment that can lead to collaborative efforts. They have access to students who are not only trained in multimedia, but who are also familiar with a cross-disciplinary team-working environment. They also are represented on IMSC's Scientific Advisory Board, which provides guidance on the Center's activities.

Internet streaming . . .

(Continued from page 1)

Industry and Technology Transfer Programs.

Led by Profs. Roger Zimmermann and Cyrus Shahabi, the team of IMSC investigators also included Profs. Chris Kyriakakis, Tomlinson Holman and Christos Papadopoulos as well as several IMSC graduate students.

The video demonstrations included:

- Synchronized streaming of five video channels, with two of the video channels coming from AboveNet's co-location facility in El Segundo, routed by way of San Jose (real-world, shared Internet), showcasing:

- Immersivision panoramic (360-degree) video display composed of five MPEG-2 video streams at 4 Mb/s each for a resolution of more than 3000 x 480 pixels.

- The Yima™ advanced media streaming server, a highly scalable, fault-tolerant PC-based solution available for licensing from IMSC.

- Synchronization of five 30fps streams to single frame accuracy.

- High resolution, full-screen displays.

- A high definition (HD) video stream from AboveNet, shown on IMSC's HD front-projector, delivered over a real-world, shared Internet route. The HD content is encoded at a resolution of 1280 x 720 (720p) in MPEG-2 format and requires a bandwidth of 19.4 Mb/s.

- The simultaneous streaming of five different combinations of MPEG-2 and MPEG-4 movies, with pause and resume, with three of the streams coming from AboveNet, demonstrating real-world video-on-demand application.

The audio demonstration achieved the first successful streaming of 10.2 channels of uncompressed audio (CD-quality, 16-bit PCM), also from the AboveNet co-location facility in El Segundo via San Jose, over the commercial Internet to IMSC's 10.2 channel sound system in the laboratory. The channels were synchronized to sample accuracy, and the bandwidth required was approximately 10 Mb/s. Prof. Kyriakakis said the possible applications of this audio capability include remote mixing and remote multi-channel audio playback.

IMSC plans additional experiments in video and audio synchronization, including the presentation of a live-capture event that will allow live concert streaming and the re-creation of the concert experience in the laboratory. The Center will be recruiting industrial sponsors for these technology demonstration experiments, and interested companies should contact Dr. Maya at (213) 740-2592.

New software . . .

(Continued from page 2)

data and processing model designed to support stream synchronization in a concurrent processing framework.

Applications are built in a data-flow programming model, as the specification of data streams flowing through processing centers, where they undergo various manipulations.

This extensible model allows the encapsulation of existing data formats and standards as well as low-level service protocols and libraries, and makes them available in a system in which they can interoperate.

The Image Toolkit Library encapsulates the Intel® Image Processing Library.

The Graphics Toolkit Library provides a generic and extensible photometric and geometric description framework in which any model at any level of semantic representation can be integrated or translated for efficient and/or high-quality rendering.

The Windows Toolkit Library regroups Windows-specific modules for video capture and display.

Dr. François pointed out that other modules implementing specific algorithms can be licensed from IMSC.

For information on licensing, contact Dr. Isaac Maya, IMSC's Director of Industry and Technology Transfer Programs, at (213) 740-2592.

New SAB chairman . . .

(Continued from page 2)

time of economic difficulty in the information technology industry, and

- Being watchful for the high-value business payoff for multimedia research from IMSC.

He encouraged SAB members to contact him by email (baker@pal.xerox.com) or by phone (650) 813-7589 if they have input on these or other issues.

Director's Message . . .

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15 projects. This program has been very successful in providing undergrads with valuable research experience while working with IMSC graduate students and investigators.

Last month, IMSC weighed in with three papers at SIGGRAPH '01, the annual conference of the Association for Computing Machinery's subgroup for graphics, held this year at the Los Angeles Convention Center.

IMSC investigator Prof. Mathieu Desbrun and Dr. Pierre Alliez, an IMSC post-doc, authored "Progressive Encoding for Lossless Transmission of Triangle Meshes," and Prof. Desbrun was one of the authors of "Dynamic Real-Time Deformations using Space and Time Adaptive Sampling."

Jun-Yong Noh, an IMSC Ph.D. student, presented "Expression Cloning," which he and I co-authored. In addition, IMSC

investigator Prof. Skip Rizzo organized and chaired a SIGGRAPH panel on "Immersed in Anxiety or a Process to Healing? Virtual Reality Meets Mental Health." Prof. Rizzo also was the Guest Editor of "Virtual Reality Applications in Neuropsychology," the August special issue of the MIT journal "Presence."

These are just a few examples of IMSC's world-class research, and I foresee an active and productive academic year ahead.

Dr. Neumann's work . . .

(Continued from page 1)

where his focus was on parallel algorithms for interactive volume-visualization.

His research in the area of video-based tracking systems for Augmented Reality applications in manufacturing and training earned him a National Science Foundation CAREER award in 1995. Dr. Neumann's research in 3D modeling and animation systems earned him the Junior Faculty Research Award at USC in 1999.

He has published extensively at conferences and in peer-reviewed journals and is active in conference organization and technical committees. He is an Associate Editor for the Institute of Electrical and Electronics Engineers (IEEE) Transactions on Multimedia.

In his commercial career, Dr. Neumann designed multiprocessor graphics and digital signal processing systems, co-founded a video game corporation and independently developed and licensed electronic products.

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