

Annenberg Center, IMSC Announce \$1 Million Immersive Sound Research Initiative

The USC Annenberg Center for Communication and the Integrated Media Systems Center (IMSC) at the USC Viterbi School of Engineering have inaugurated an expanded partnership, which will include significantly increased Annenberg Center support for IMSC research.

"We are excited by the potential for this new initiative," said Adam Clayton Powell III, Director of IMSC. "With this new support, IMSC further explores the very limits of immersive sound, sound reproduction and human perception."

Immersive Sound is cutting-edge research at the intersection of audio, psychoacoustics and signal processing, and it will produce milestones in the next year in all four IMSC research clusters — Scalable Immersive Environments, Decision Support, Serious Games and Human Performance Engineering.

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IMSC Partners with Institute for the Connected Society for Research and Global Forums

The USC Viterbi School's Integrated Media Systems Center will partner with two leading media analysts in a new non-profit institute, iFOCOS, the Institute for the Connected Society.

IMSC will work with iFOCOS co-founders Andrew Nachison and Dale Peskin to establish partnerships with individuals and organizations around the globe to conduct research and to create next-generation media projects that foster an informed society, as well as create new opportunities in the marketplace.

"We at IMSC are looking forward to working with iFOCOS," said Adam Clayton Powell III, IMSC's director. "We plan on developing partnerships that will lead to cutting-edge research to produce digital media solutions for news, information, education and entertainment."

The affiliation with IMSC positions iFOCOS at the intersection of media, technology and society, say the group's founders.

"We'll be working with one of the world's outstanding media labs to develop and understand a dazzling array of information technologies that will continue to transform media, media businesses and our connected society," said Nachison, who will serve as executive director of the iFOCOS.

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(Top) Andrew Nachison and Dale Peskin

Serious Games Lab: Firefighter's Drill Time

Working closely with members of the Los Angeles County Fire Department's, Ladder 164, IMSC's Serious Games Lab is developing an immersive audio training and simulation application for firefighters.

Firefighter's Drill Time is a unique implementation of an immersive simulation scenario that helps in the training of firefighters and first responders. The goal is to use IMSC's 10.2 immersive audio to produce

an accurate sonic representation of a fire scene so participants can navigate and explore, as well as interact with and react to sound objects within the environment.

The intent is to show through assessment methods that the situational awareness of the trainee is raised, while being immersed in realistic levels of stress. This means that on-the-spot decisions must be made similar to what would be needed during an actual

emergency scenario. Immersive audio rendering will be used to vary in a systematic way the emotional state and anxiety level of the trainees. The goals and learning objectives in specific training missions will be facilitated through game-play. Database techniques with multidimensional dataset queries will support modeling users and profiling performance.



from the Director

IMSC@X — Sensing the Edge, Serving a Need

IMSC celebrates its tenth anniversary this year, as we continue to transition from full NSF funding to “graduation,” self-sufficiency and a more diverse revenue stream. It is a time for looking back and for looking ahead.

Looking back, IMSC began at a time when Internet browsers were new and streaming media was barely moving from laboratory to beta. And as you can see in the accompanying article “Revenge of the West Coast Nerds” by Chris Kyriakakis, (see page 5) IMSC’s mid-1990’s projections of both technology and research activity proved to be almost eerily prescient. Fueled by a decade of investment by the National Science Foundation, USC and dozens of industry partners, the Center achieved a high percentage of the goals identified by its first Director, now Provost, C. L. “Max” Nikias.

Looking ahead, the only constant is change: The pace of technological innovation continues to accelerate, and the pace of advances in IMSC research in audio and psychoacoustics, video and visualization, and serious games and haptics will also move more briskly.

The universe of IMSC industry partners has also changed considerably, even in the past year, and those changes will most

certainly continue. Building on a strengthening base in information technology, with Honeywell joining as a new partner this year, IMSC research now embraces new industry partners in journalism, in education and in museums.

Where will IMSC be in its 20th year? One answer comes from John Seely Brown, a new member of the IMSC Board of Councilors, who characterizes the Center’s research as “*sensing the edge*,” a deft play on words reflecting the Center’s focus on interfacing with human senses while exploring the technological edge.

But IMSC is not just conducting research for the sake solely of research. Increasingly, the Center’s faculty and students are directing their work to address critical national and international issues and needs, from education and training to health care and the preservation of cultures. It is both *sensing the edge* — and *servng a need*.

—Adam C. Powell III
Director, IMSC



Technology Guru Joins IMSC as 2006-2007 Canada-U.S. Fulbright Visiting Research Chair

Technology visionary Cory Doctorow has been selected as the first holder of the Canada-U.S. Fulbright Visiting Research Chair, which will be co-hosted by the Integrated Media Systems Center. In his new role, first announced by the Canadian Fulbright Commission, Doctorow will collaborate with USC faculty and students and deliver guest lectures to the wider community.

“I’m looking forward to being part of the academic discourse on the ways that technology can either liberate or control us,” Doctorow said.

“We are excited by this opportunity to work with such a visionary as Cory Doctorow as we continue our research on experiential media for education, journalism and entertainment,” said Adam Clayton Powell III, Director of the Integrated Media Systems Center.

Doctorow, who edits the widely read culture and technology blog site “boingboing.net”, will divide his appointment at USC between IMSC and the USC Center on Public Diplomacy.

“In an era in which technology is changing the very rules by which people around the world learn about each other, it is critical that public diplomacy be current,” said Joshua S. Fouts, Director of



the USC Center on Public Diplomacy. “Cory Doctorow will bring a valuable perspective to the discussion taking place here at USC.” Under this new program, a different prominent Canadian will come to USC each year. “The research agenda advanced by this new Fulbright Chair in Public Diplomacy is particularly important in the context of today’s increasingly complex international environment,” said Michael K. Hawes, executive director of the Canada-U.S. Fulbright Program.

Immersive Sound Research Initiative

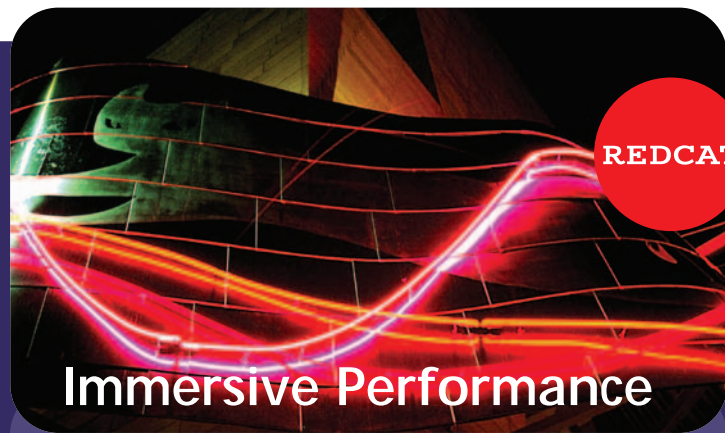
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"The USC Annenberg Center's partnership with IMSC and the immersive sound project, is a concrete example of our common commitment to leading-edge, interdisciplinary research to promote innovation in communications technology," says Jonathan Aronson, executive director of the USC Annenberg Center for Communication.

The partnership with IMSC, now in its tenth year, is part of the USC Annenberg Center's focus on the impact of new communication and information technologies on politics, society, and innovation. Immersive Sound is a leading component of the innovation research cluster.

Chris Kyriakakis, IMSC Deputy Director, will serve as Principal Investigator of the expanded Immersive Sound research initiative. He is also the founding director of the IMSC Immersive Audio Laboratory, which for the past ten years has conducted leading interdisciplinary research in the areas of multichannel audio signal processing, room acoustics, and immersive musical performance capture and rendering.

"We have an opportunity to not only pioneer a new interdisciplinary field," said Professor Kyriakakis, "but also to make USC the leading institution in Immersive Sound with research that cuts through traditional school boundaries."



Immersive Performance

The goal of Immersive Performance is to provide the performers and the audience with the sense of being in the same acoustical and visual space, with comparable abilities to perceive, interact, and perform as if they were in the same physical space. This is distinct from any previous experiment in networked performance because all of that work was based on 1-2 channels of audio communication and video resolutions that were below standard definition television. The objective of this project is to use immersive audio to create a sense of co-presence among musicians and audience that will eventually be indistinguishable from actually being there. The potential of this type of experience has profound implications in Communications, by enhancing remote interactions with the richness of in-person interactions; Education, by enabling distributed instructors and students to come together in interactive learning environments; Science, by enabling rich remote collaborations and sharing of experimental facilities; Arts and Entertainment, by bringing in as participants people who otherwise could not make it to a particular performance venue.

A immersive performance test bed will be installed (this Fall) in the Roy and Edna Disney/CalArts Theater (REDCAT) at Disney Hall in Downtown Los Angeles where students from USC and CalArts will work with renowned performers on experiments in immersive performance.

REDCAT photos courtesy of CalArts Photography

A Salute to True Pioneers

—C. L. Max Nikias

USC provost and senior vice president for academic affairs

The word *pioneer* is used so frequently in our day that we often use it without considering the full and rich implications of the word.

I am grateful beyond words for the many *true* pioneers—faculty, staff members, industry partners, supporters and advisers—whom I encountered during the birth of the IMSC.

A pioneer is not merely a pace-setter or a forward-thinking person. A pioneer, properly understood, is someone who gladly faces uncertainty or hardship in pursuit of something elusive, something precious. With no guarantee of success—and with considerable risk of failure—they press onward along a new frontier, because no other option strikes them as worthy.

Any university organization seeking a National Science Foundation (NSF) designation as an Engineering Research Center (ERC) knows that it faces long odds—typically no better than a one in 25 chance of winning—an almost guaranteed 96% chance of failure. Given this, I am struck by the number of IMSC faculty, staff and partners who passionately contributed their full talents

along the long, arduous task of submitting an NSF proposal, going back to our first meeting in the presidential boardroom in 1992.

Our first multimedia conference, held the next spring in the gerontology school's auditorium, was a wonderfully attended success

that confirmed the value of our efforts. Yet our initial NSF proposal, as outstanding and comprehensive as it was, was turned down. While this could have been a discouraging turn of events, I am reminded of an old Greek proverb: A great goal, pursued vigorously, is a noble endeavor even if success is not attained.

More key faculty, partners and supporters joined our cause, and they helped the IMSC team strengthen an already excellent proposal. Our follow-up proposal, in 1995, did succeed—ranking *first* among 117 proposals, many of them representing the most elite research universities in the land.

The IMSC pioneers of this communications frontier are far too numerous to mention in this small space. But together, they indeed seized upon a great goal—the establishment of a national multimedia center that could make a significant contribution to the nation's research enterprise—and pursued it with determination and originality.

My life and my career were enriched considerably by the opportunity to work with, and learn from, such men and women.

Can there be any greater privilege than to be associated with such a remarkable group of people?



IMSC Partners with Institute for the Connected Society

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Nachison and Peskin will also be affiliated with the USC Annenberg School of Journalism. Prior to founding iFOCOS, both men directed The Media Center at the American Press Institute.

A board of advisors has been recruited from the world's most influential digital media companies to advise and support the institute, including QUALCOMM, Yahoo, Ogilvy Public Relations Worldwide, FastCompany magazine, The Associated Press, the British Broadcasting Corporation, and Reuters.



The Reston, Virginia-based institute will announce cross-sector collaborations with institutions, businesses, foundations, research centers, public policy groups and individuals in coming weeks.

One of iFOCOS's first actions is organizing the international "We Media" forum at the University of Miami, February 8-9, 2007, with support from the John S. and James L. Knight Foundation and participation by Grupo de Diarios America, a coalition of Latin-American media groups. Previous "We Media" conferences were conducted in New York and London in association with news organizations, including The Associated Press, the BBC and Reuters.

"iFOCOS will lead international collaborations such as 'We Media' to understand how we can use media and new information technologies to anticipate changes on the road ahead," said Nachison. "As conveners and as facilitators of innovation, we will continue to bring productive groups together to address complex issues impacting audiences, communities and a society defined by media. Partners will contribute to an exciting dialogue and also walk away with ideas they can apply to their business and organization today."

In addition to its event and research agendas, iFOCOS has established a practice to work with organizations and individuals on media strategies, projects and funding. The practice spans traditional channels of private and public media, from broadcasting and publishing to telecommunications and the "long tail" of personal and niche media.

"The rules are changing and so are we," said Dale Peskin, iFOCOS's co-founder and director. "We believe that media is a powerful source for innovation and a vital instrument for change in our society. We have a rare opportunity to inform crucial decisions about our future. iFOCOS and its partners will help steer innovation, broker collaborations and stir conversations that make a difference."

The board of advisors to the institute includes:

- Jeff Belk, SVP, QUALCOMM
- John Bell, Managing Director/Executive Creative Director, Ogilvy Public Relations Worldwide
- Merrill Brown, Principal, MMB Media
- Carin Dessaur, Principal, mc2
- Scott Fox, CEO, Global View Partners
- Jim Kennedy, VP, Strategy, The Associated Press
- Susan Mernit, Product Manager, Personals, Yahoo!
- Craig Newmark, Founder, craigslist.org
- Adam Clayton Powell III, Director, USC Integrated Media Systems Center
- Scott Rafer, CEO, My Blog Log
- Brian Reich, Senior Strategic Consultant, Mindshare Interactive Campaigns
- Richard Sambrook, Director, Global News Division, BBC
- Karen Stephenson, President, NetForm
- Alan Webber, Founder, FastCompany magazine
- William C. Weiss, Chairman and CEO, The Promar Group
- Dean Wright, SVP and Managing Editor, Consumer Services, Reuters America

More information is at the iFOCOS website, at <http://www.ifocos.org>.



IMSC Faculty Member C.C. Jay Kuo Takes Reins at SIPI

Veteran researcher to lead signature Viterbi Institute for three-year term

Jay Kuo, who joined the USC faculty in 1989 and is one of the creators of the widely used MPEG video compression system and is the newest director of the Viterbi Schools Signal and Image Processing Institute (SIPI).

Established in 1971 under the deanship of the legendary Zohrab Kaprielian by William K. Pratt and Harry C. Andrews with support from the Defense Advanced, SIPI was the first academic unit in its speciality, and has become internationally known as a center for its discipline. SIPI research created the now universally used JPEG and MPEG systems.

Kuo will also assume directorship of the allied USC Signal Image Processing Group (SIPG). Sawchuk commended the outgoing director, Antonio Ortega, for "outstanding previous service" at SIPI. Ortega, like Kuo, is a specialist in image and video compression.

Kuo is a professor in the Viterbi School Department of Electrical Engineering, and member of SIAM, ACM, a Fellow of IEEE and SPIE. He is Editor-in-Chief for the *Journal of Visual Communication and Image Representation*, Associate Editor for *IEEE Transactions on*

Speech and Audio Processing and Editor for the *Journal of Information Science and Engineering* and the *RURASIP Journal of Applied Signal Processing*.

He served as Associate Editor for *IEEE Transactions on Image Processing* in 1995-98 and *IEEE Transactions on Circuits and Systems for Video Technology* in 1995-1997. Kuo received the National Science Foundation Young Investigator Award and Presidential Faculty Fellow Award in 1992 and 1993, respectively. He has guided 35 students to their Ph.D. degrees and is the author or co-author of more than 500 technical publications in international conferences and journals as well as three books. He holds a Ph.D. in Electrical Engineering from MIT.

SIPI's website sipi.usc.edu, details the Institute's history and current work: "Research in SIPI has been at the forefront of signal processing with fundamental work on the development of signal processing theory based on higher-order statistics, fuzzy logic and artificial neural networks."

Revenge of the West Coast Nerds

—Chris Kyriakakis
Deputy Director, IMSC

That was the title of the September, 1996 *NY Times* article announcing to the world that USC had been awarded an NSF engineering research center called IMSC. The *NY Times* writer, (I'm not making this up), started the article trying to be clever:

"This intrepid band of West Coast engineers doesn't have a charismatic *Wired* magazine columnist and celebrated author like Nicholas Negroponte as their leader."

Oh really? How interesting that being a *Wired* magazine columnist was the pinnacle of fame and charisma at the time. But then again, this was the mid-90s.

The actual NSF announcement had come three months earlier on May 23rd, 1996 and Karen Kaplan of the *LA Times* had the scoop:

"Giving a major boost to Los Angeles' hopes of becoming the world capital of the fledgling multimedia industry, the National Science Foundation is expected to announce today that USC has won a hard-fought competition to become the country's only national engineering research center for multimedia."

At the time there were some who looked at CD-ROMs and declared that the multimedia revolution had already happened.

The IMSC research program was structured to demonstrate that a much more compelling and powerful future lay ahead: Immersive Reality enabled by integrated media systems that went beyond text, elementary graphics, and low fidelity sound to fully-immersive environments that would bring people from remote locations to learn, play, and work together.



The original research program proposed to NSF was structured in three interrelated thrusts, described ten years ago in these words:

Creator-Computer-Consumer

Interfaces (C3I). Research in this area is focused on the development of advanced human-machine interfaces based on tracked head-mounted displays for applications in the industrial workplace, the extension of emerging smart camera technology to functions such as human expression recognition and unstructured environment orientation, the implementation of seamless and immersive multi-participant telepresence systems, the development of prototype

autostereoscopic 3-D displays, advances in robust speech recognition and synthesis, and the development of tracked immersive sound environments.

Media Interconnection and Delivery Fabrics (MIDF).

Research in this thrust area integrates artifact-free image compression, decompression, and coding; the implementation of high bandwidth fiber-based interconnection networks and network interfaces for large data block and image-intensive information exchange among locally interconnected workstations, high resolution displays, and high bandwidth local area networks linked to the Internet; and the development of wireless network architectures and protocols for the untethered interconnection of large-scale databases with mobile personal data assistants and head-mounted displays.

Distributed Media Information Management (DMIM).

This thrust focuses on next-generation multimedia database technology, including the structuring and automatic indexing of image, video, and digital audio data; the display of continuous media types in library information, education, and

entertainment systems; the interconnection, sharing, and exchange of structured units of information in a distributed integrated-media database environment; and the implementation of front-end presentation, extraction, and guidance tools for integrated media.

The names and acronyms may have changed, but a careful look at the three paragraphs above (from 1996) shows that the IMSC course not only did not deviate much from the plan, it actually delivered a significant portion of the deliverables promised to NSF 10 years ago.

Looking back at the list of promised milestones one finds that about 80% of what was predicted in 1996 was actually delivered, published, and demonstrated: Smart cameras, expression recognition, network-based communication and collaboration, immersive sound, speech recognition, immersive telepresence prototype, immersive classrooms and concert halls, augmented reality, and multimedia networked databases.

There were also predictions about where some of these technologies may contribute. One, in particular, rings true today:

"Personal multimedia electronics: Low power, wireless systems provide multimedia network applications to the individual."

President Sample's said it best in 1996: "I see the NSF grant as a match on a little gasoline. It will start a bonfire of research and innovation".

Over the past 10 years, that bonfire has grown to a firestorm and it will keep burning well into the future.



*"I see the NSF grant as a match on a little gasoline.
It will start a bonfire of research and innovation"*

—USC President Steven B. Sample, 1996

IBM Names Leslie S. Liu as Emerging Leader in Multimedia

Leslie S. Liu, a Ph.D. student in Computer Science, was selected as one of only eight students from top universities in the US to participate in the IBM organized *Emerging Leaders in Multimedia Workshop* series. The seminar, organized by Deepak S. Turaga and Gopal S. Pingali, was held at the IBM T.J. Watson Research Center on October 16 and 17 in Hawthorne, New York.

The eight participants were chosen from a number of relevant disciplines across research topics within multimedia.

recognize outstanding student researchers in the multimedia area and enable a fruitful dialogue with IBM researchers.

"This was an exciting opportunity and an acknowledgment of my work," Liu said about the honor of being selected. "I was especially beneficial to meet other leading researchers in the multimedia field and to learn about the latest developments at IBM Research."

Liu's research focuses on large-scale interactive media streaming technologies. Research Assistant Professor Roger



Leslie S. Liu

"I am excited about this opportunity and it is an acknowledgment of my work," Liu said about the honor of being selected. "I am especially looking forward to meeting other leading researchers in the multimedia field and to learn about the latest developments at IBM Research."

The criteria for the students' selection included recommendations from both IBM researchers and the students' advisors, their research experience and their publication record.

This year's workshop marked the second installment of the seminar series. Its format was expanded to one and a half days from last year's successful single day inaugural event, according to Deepak S. Turaga, a research staff member at IBM.

The event consisted of presentations of the students' research, demonstrations of multimedia research currently ongoing at IBM, and several interactive sessions among students and researchers on open and emerging problems in the field, and exciting directions for future research. The students also had opportunities to engage in one-on-one meetings with leading IBM Multimedia researchers. The goal, according to Turaga, was to

Zimmermann is his advisor in the Ph.D. program. Liu's most recent work has been presented at the prestigious *ACM Multimedia* conference, where in 2005 he co-authored a paper on mobile peer streaming, and this year demonstrated a peer-to-peer based Massively Multi-player Online Game (MMOG).

Liu is a co-inventor of a peer-to-peer streaming architecture, which is currently being patented (application no. 11/504, 536), and he was a member of the USC team that qualified for the US Finals of the *Imagine Cup 2006*, a world-wide software design competition held at Microsoft's headquarters in Redmond, Washington. In addition Liu has presented his work at both the 2005 and 2006 *Technology Expo*, organized by USC's Graduate Technology Alliance, and he is a recipient of IMSC's Industry Award for Excellence in Technology Demonstrations, 2003.

IMSC research presented at Africa's largest media technology conference

Current IMSC research was presented at the tenth annual Highway Africa conference, the largest gathering on media technology on the African continent. 2006 research in Scalable Immersive Environments, Decision Support and Serious Games were presented at the opening plenary session by IMSC Director Adam Powell.

Among the topics was the 2006 milestone in intercontinental streaming technology, a principal focus of IMSC research with Pratt and Whitney, Korean Airlines and Korea's Inha University. Applications of this technology to Africa were clear, as it could be used to link African airports with experts at manufacturers in North America and Europe.



Delegates were also interested in educational applications of Serious Games, such as IMSC's high school biology software deployed at Washington D.C.'s McKinley High School; Distributed Immersive Performance, to bring musicians and artists to remote villages; and applications of Internet-connected rehabilitation for remote medicine in Africa

Journalists at the conference saw immediate applications for AVE and GeoDec imaging technologies (see page 8). But participants expressed concern about the potential for abuses by governments and implications for personal privacy posed by the technology.

Powell was one of two speakers at the opening plenary. The other was Dali Mpotu, Group Chief Executive Office of the South African Broadcasting Corporation, the continent's largest broadcaster. Mpotu described Africa's migration from analog to digital technologies, and what those technical changes will mean for programming, finance and government regulation.

IMSC Peer to Peer Work Shared at Video on the Net Conference

The question "Is Video Peer to Peer a Money Making Option?" was recently pondered by Prof. Roger Zimmermann and several other panelists during a roundtable discussion at the Video on the Net conference. The successful inaugural event of Video on the Net was held at the Boston Convention and Exhibition Center (BCEC) from September 12 through 14.

The purpose of the forum was to examine the effects of the broadband Internet on the movie, TV and broadcast industries. Organized by pulvermedia, the conference was established as part of the Fall 2006 VON conference. VON, originally short for Voice on the Net, is a forum that is held bi-annually during spring and fall in the United States, as well as annually in Europe, Mexico and other locales. Initiated by legendary Internet pioneer Jeff Pulver in 1996, the VON conference (then called "The Talking Net") helped to define and shape a new industry over the last decade during which VoIP (Voice over IP) has evolved from an obscure technical acronym to a household word. Video on the Net was a logical extension of VON as video distribution over the Internet has taken off during the last few years.

The other participants on the panel included Bram Cohen, CEO and co-founder of BitTorrent, Michael Weiss, CEO of StreamCast Networks, and moderator Patrick Norton, executive producer of Ziff Davis Media.

Noting that video over the Internet is a disruptive technology for the movie, TV and broadcast industries, the panel agreed that network bandwidth is one of the key issues going forward. Computer power and storage are now affordable, even for large video distribution sites. Bandwidth, however, is still expensive. As an example Weiss mentioned the popular YouTube site with its

nearly \$1 million monthly network bill. While YouTube has some deep-pocketed partners, smaller businesses may have a difficult time to break even in such an environment. Peer-to-peer techniques have the potential to change this equation and remove the bandwidth bottleneck from central sites.

Hence, one of the key questions is how to monetize video on the Internet. While popular movies and TV shows can demand a high enough per-download price for a sustainable business model, more specialized videos may need to be offered at a lower cost. It was the consensus of the panel that "The Long Tail" of less popular videos can only be distributed cost-effectively with a peer-to-peer model. To further lower the cost charged to customers, on-line advertising can be a significant source of revenue.

All of the participants have a background in media and p2p technologies. Bram Cohen is the designer of the popular BitTorrent protocol and Streamcast Networks is the

originator of the Morpheus network. Zimmermann has worked on video streaming for more than a decade, designing some of the fundamental algorithms of media distribution architectures. The Yima media server developed at IMSC became the foundation of the pioneering Remote Media Immersion (RMI) system. RMI, a breakthrough in Internet technology, demonstrated high resolution, big-screen digital video streaming and multichannel audio at a time when broadband was still in its infancy.

Recently Zimmermann has focused on peer-to-peer large-scale group communications. For example, his team designed the ACTIVE protocol that combines advantages of a centralized approach with the decentralized nature of a p2p topology. It is specifically designed for live media streaming, something that he expects to take off on the Net in the future.



Patrick Norton, Michael Weiss, Roger Zimmermann and Bram Cohen (left to right) fielded pointed questions by an inquisitive audience of industry and business conference attendees.



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IMSC Faculty Launch Start-Up with AVE Technology

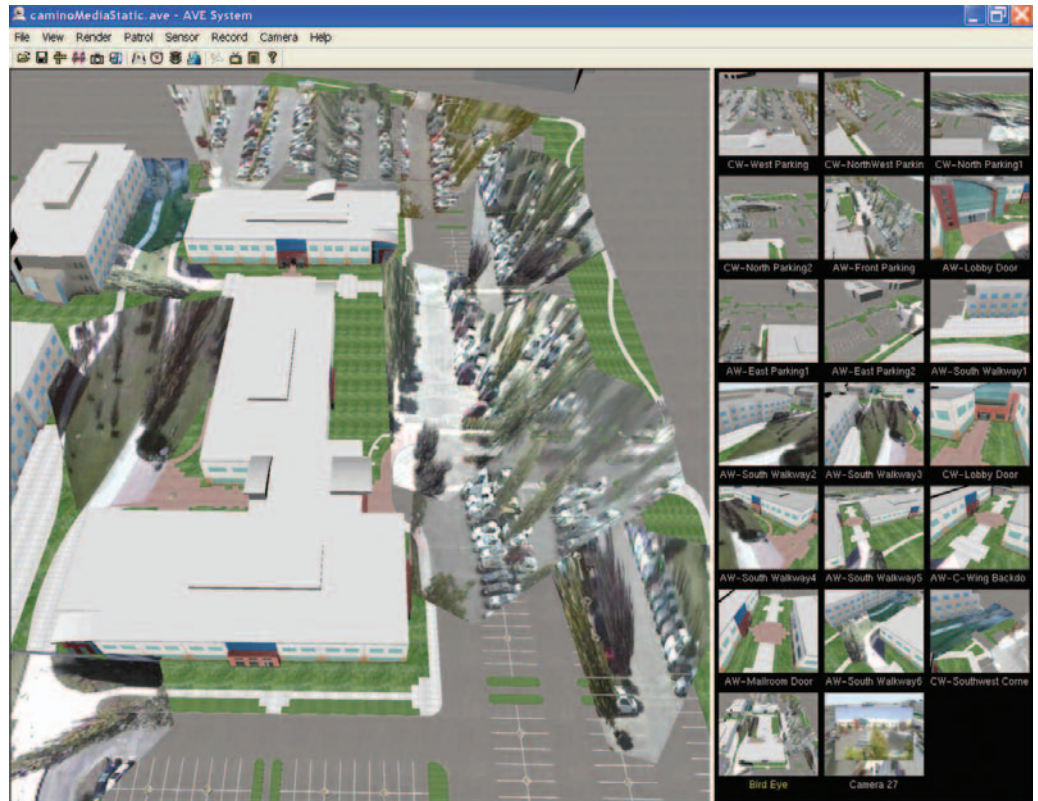
Recent visitors to IMSC have been drawn to Augmented Virtual Environment (AVE) technology that fuses multiple real-time video images by projecting them onto a 3D model to provide a "bird's-eye" view of a scene. AVE systems are capable of viewing and managing hundreds of cameras, providing users with unprecedented comprehension of real-time imagery over large areas.

AVE is used in the IMSC geospatial decision making tool, GeoDec. The GeoDec project has demonstrated video projection onto models of the USC campus and sections of downtown Los Angeles and Washington DC. Over the last several months, AVE has also found applications for the USC-Chevron Center of Excellence for Research and Academic Training on Interactive Smart Oilfield Technologies (Cisoft), where the technology

was ultimately directed at its first commercial application.

Early in 2006, IMSC researchers, professor Ulrich Neumann and Suya You licensed AVE technology to their new USC start up company, Sentinel AVE, LLC. Over the summer, an AVE system

was installed in the Chevron offices in Bakersfield, CA. Neumann added that "The future of AVE technology is immeasurable, as we envision endless



This screen shot shows real-time video from 12 cameras projected into a scene model. The thumbnail images on the right are pre-set views used to facilitate detailed inspection of areas of interest by steering nearby PTZ (pan, tilt, zoom) cameras to optimal views.

possible applications for the blossoming technology." Future AVE installations are expected by Chevron in oilfield exploration to enhance security and operations by providing a clear picture of all activities over a wide geographic area. Sentinel is also integrating AVE technology into a system for clients in the aerospace and

defense industries. Professor Neumann believes that, "Sentinel's AVE systems provide a unique capability to manage and present video information in security applications said Professor Neumann. We also see applications in spatial information services such as Google Earth and MSN Virtual Earth in the near future."



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