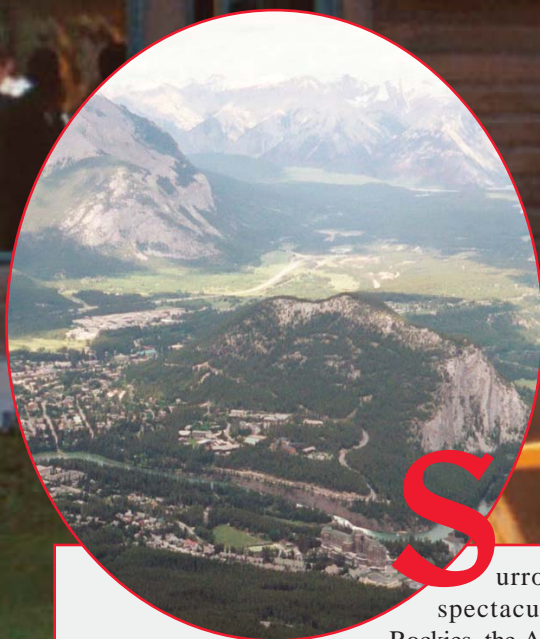


AES 24th INTERNATIONAL CONFERENCE

Multichannel Audio: The New Reality

The Banff Centre
Banff, Alberta, Canada
June 26–28, 2003



Surrounded by the spectacular Canadian Rockies, the AES 24th International Conference in Banff, Canada, *Multichannel Audio: The New Reality*, followed up on the same theme first established at the 19th Conference held in 2001 at Schloss Elmau, Germany, in the equally awe-inspiring Bavarian Alps. Over 180 audio engineers from around the globe came to share the latest developments in multichannel surround audio amidst the

snow-tipped mountains rising majestically from the verdant wooded valleys. With bear and elk frolicking in the nearby woods, attendees were warned to go in groups and make plenty of noise when venturing out on the wide selection of hiking trails.

The Banff Centre is a major international outpost promoting and nurturing the arts and new media. Theresa Leonard, its director of audio and chair of the conference, spent long hours during the past two years preparing for this remarkable event.



Speaking at conference opening: clockwise from above left, Theresa Leonard, conference chair; Joanne Morrow, Banff Centre senior VP of programming; Isobel Rolston, Banff Centre artistic director; George Massenburg, keynote speaker; Kees Immink, AES president; and Geoff Martin, 24th papers chair.



music & sound
building

Together with her hard-working committee—John Sorensen, vice chair; Geoff Martin, papers chair; Joe Missio, facilitator; and Mark Wold, conference coordinator—she created a program that was packed from morning until night with technical papers, seminars, demonstrations, and panel discussions. Complementing this was a program of receptions and cultural events in the evenings, exposing delegates to the Banff Centre's exceptional culinary and artistic delights.

The overall program of the 24th Conference followed a sim-

ilar structure to that of the 19th, consisting of research papers paralleled by sessions aimed at more operational and practical issues. By this means scientific and operational members of the Society were brought together under one roof with a unique opportunity for crossfertilization. Seminars provided speakers with the opportunity to demonstrate and discuss surround audio technologies and techniques in the the Banff Centre's Rice TV Studio, equipped with 5.1 monitoring and video reproduction for an audience of 80 people. Further small ➔



Some of the authors who presented papers: clockwise from top left, Jan Berg, Günther Theile, Robert Höldrich, Tim Muzio, Ralph Glasgal, Diemer de Vries, and Natanya Ford.



demonstrations enabled critical material from these seminars to be replayed to a discerning audience under better acoustical conditions. Complementing all this was a program of additional demonstrations set up in rooms around the campus, enabling the presentation of a broad range of spatial audio technologies from different individuals and companies.

OPENING AND KEYNOTE ADDRESS

Opening the conference, Theresa Leonard sincerely thanked her committee and AES headquarters staff for their sterling efforts in bringing this conference to fruition. She then introduced Joanne Morrow, senior vice president of programming at the Banff Centre, who welcomed delegates to the venue. Isobel Rolston, artistic director, spoke next about the Banff Centre's programs in leadership development and the arts. AES President Kees Immink offered his own warm welcome to delegates, and he said, tongue-in-cheek, as he gazed at the magnificent mountain vista just outside the window that it was so much nicer being in Banff rather than, say, Siberia.

George Massenburg, chair of the AES technical committee on studio practices, renowned engineer and producer, as well as innovator of numerous audio developments, offered a keynote address that highlighted the challenges facing delegates in developing the multichannel audio business. He started by suggesting that making multichannel successful is prob-

ably easier than moving the mountains outside the window, but still difficult. Multichannel audio retailing, though, can be considered a huge success because of the very large numbers of replay systems being sold, albeit often at the low to middle end of the home-theater market. Classical music, he said, is sadly still much more likely to be delivered in 2-channel form, and many of the major labels have all but abandoned classical music. Movie theaters on the other hand are nearly all 5.1- or 7.1-equipped, and Dolby EX is providing a valuable extension to this technology by adding a center-rear channel. Massenburg implied that here there is rarely support for extended bandwidth or resolution but always for more speakers.

DVD-Video, he continued, is proving to be a great success, and TV and radio broadcasting are beginning to deliver 5.1 surround in earnest now, particularly such examples as Swedish Radio and the emerging high-definition services in the United States. In the pop field he reported that if a surround title sells 50,000 to 100,000 copies it is generally considered a success, whereas a stereo title must sell more like three million to be a hit. Recent releases, though, such as the surround remix of Pink Floyd's *Dark Side of the Moon* have proved to be highly successful.

In-car audio presents a big challenge in the delivery of convincing surround audio to all passengers, and Massenburg pointed to the difficulties he foresaw in the adoption of



Authors Andreas Dantele (top) and Mike Williams explain poster presentations.

a limited bandwidth center channel in such environments. Games are an exciting opportunity for introducing surround sound, but audio data rates are typically squeezed in the overall bit budget for such media, limiting the options available to the game programmer; he cited the recent *Lord of the Rings* release as an example where the music has been reduced to 2-channel stereo from the surround stems that had been provided.

Massenburg said that once people experience multichannel surround audio they don't want to go back to stereo. Various new tools such as virtual room technology are needed urgently, and developments such as wavefield synthesis are fascinating and definitely part of the future of multichannel audio over the next 30 to 40 years. Concluding, he left the audience with the suggestion that there is no better time to experiment with multichannel than now, while the record industry is in "melt-down" and often producing execrably bad music.

TECHNICAL PAPERS

The papers program consisted of 30 papers and six poster presentations, covering topics in: Alternatives to 5.1; Wavefield Synthesis; Perception of Spatial Sound; Automotive Audio; Transmission, Spatialization and Reverberation; Signal Processing; and Microphone and Mixing Techniques.

Substantial attention was given to the topic of wavefield synthesis (WFS), partly owing to the imminent completion of the European CARROUSO project that relates WFS to

MPEG-4 transmission of spatial audio. This technology, in development for many years, is gradually becoming more of a reality, and speakers such as Günther Theile were keen to show how WFS can be integrated with more conventional stereophonic techniques. Other speakers reported work on WFS such as the development of multiactuator loudspeaker panels (de Vries) and ways of evaluating its performance in conjunction with 2-D video projection (Melchior et al.).

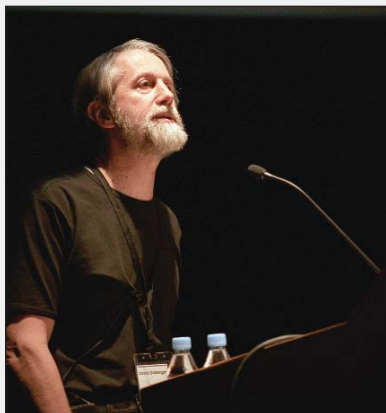
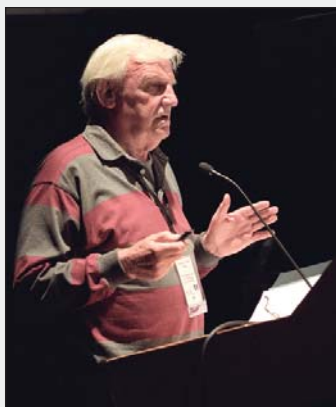
Other alternatives to 5.1 were also in evidence during the technical papers, such as Ralph Glasgal's description of Ambiphonic recording and reproduction—a means by which crosstalk-cancelled binaural source material is combined with convolved hall reverberation reproduced through separate loudspeakers. Speakers from the University of Music and Dramatic Arts in Graz, Austria, discussed a recent development known as the IEM-Cube, consisting of 24 loudspeakers for periphonic reproduction using at least third-order Ambisonics.

Perception of spatial sound received substantial coverage at the 24th Conference, accounting for one-third of the total papers, split over three sessions. Topics included the interaction between computer games and multichannel audio, presented by Slawomir Zielinski. He described an experiment that showed how some listeners were less critical of small impairments in audio quality when immersed in playing a game, but that it was not a consistent effect with expert listeners. Gilbert Soulodre described further development in objective measurements relating to listener envelopment, showing that a frequency-weighted IACC (interaural crosscorrelation) value can be used successfully in calculations. Further papers related to topics such as elevation and vertical perception, listener training tools, objective measurements, and quality-evaluation tools involving both verbal and graphical scales.

Papers related to virtual-scene generation and modeling described means by which sound-source obstruction, occlusion, and diffraction effects can be determined and controlled. There were also papers on pitch-tracking of reverberant sounds and the parametric coding of spatial audio scenes, and Sontacchi described optimization criteria for distance coding in 3-D soundfields. A particularly interesting and well-received paper by Farina and Ayalon looked at ways of recording concert hall acoustics for posterity, involving the capturing and storage of a number of different types of impulse responses, said to be compatible with all known surround formats. This idea was first proposed by Gerzon 25 years ago but has only recently received proper attention, the authors claimed. They propose a rotating boom with three different types of microphones: an ORTF cardioid pair, a binaural head, and a Soundfield microphone.

Considerable interest was also shown in the issue of Ambisonic-type panning for 5-speaker reproduction, as described by Peter Craven, who also introduced the capabilities of MLP (Meridian Lossless Packing) for hierarchical transmission of surround sound for very large numbers of channels.

Michael Williams distributed copies of his MMAD (multichannel microphone array design) CD-ROM at the conference and spoke on the topic in the final papers session. He was followed by Kimio Hamasaki who gave an intriguing paper on the reproduction of spatial impression by multichannel audio.



Among those presenting seminars: clockwise from top left, Cornelis van der Gragt, Florian Camerer, Jeff Levison, Tom Holman, Kimio Hamasaki, and David Griesinger.



ADDITIONAL DEMONSTRATIONS

There was no shortage of opportunities to listen to spatial audio of just about every flavor and color at this conference. In addition to demonstrations of multichannel technologies from companies such as Dolby, DTS, Sonoteknik, and Yamaha, delegates could experience the latest surround recordings from recording companies such as Polyhymnia in the Super Audio CD demo room.

A complete WFS setup was installed in one of the studios, consisting of a number of loudspeaker panels surrounding the listening area, each containing eight low- and high-frequency drive units, developed specially for the Fraunhofer Institute in Germany. The demonstration consisted of a number of different renderings of spatial audio material including recordings made using specialized microphone arrays and hall reverberation convolution. Virtual spot microphones were demonstrated, allowing sources to be placed in front of the loudspeakers, within the listening area—something not possible with more conventional spatial reproduction systems.

Further demonstrations included comparisons of various forms of ambiophonic and ambisonic reproduction, including a full 16-channel periphonic system demonstration by Thomas Chen. Harman Becker Automotive brought a pair of luxury automobiles equipped with surround systems that delegates could listen to. Hearing examinations were available for delegates if they wished, and for aficionados it was possible to experience a range of different computer games in surround. An old Buchla keyboard synthesizer was also on display, courtesy of the Cantos Music Museum.

SEMINARS AND PANEL DISCUSSIONS

Something for everyone was offered in the seminar program, with themes ranging from microphone and mixing techniques to novel formats such as 10.2 surround.

In “The Center Channel Challenge,” Jeff Levison discussed various ways in which this channel can be used effectively in mixes, illustrated by a range of examples from different producers. He raised issues about divergence of front-center content into the surround channels as well as into left and right, both of which could help to create a more pleasing balance. He also played examples with an advance of 1–2 ms in the center which seemed to improve the result, but some delegates suggested this could present problems with downmixes.

David Griesinger, a well-known speaker at such events, presented a variation on his theme of the physics and psychophysics of surround to an enthusiastic audience. In another seminar Tom Holman had a complete 10.2-channel system installed in the Rice Studio so that delegates could hear the effects of the addition of two height channels as well as extra front and rear loudspeakers and two subwoofers.

European broadcasters were able to show how they have been instrumental in making 5.1 surround a reality. Florian Camerer of ORF, the Austrian Broadcasting Corporation, presented his remarkable surround documentary recordings as well as a recording of a concert from Vienna that had been broadcast live by satellite on New Year’s Day. ORF has gradually been introducing surround technology into its systems, such as Dolby E for in-house systems and Dolby Digital for transmission.



Some of the many special demonstrations and presentations: clockwise from top left, Super Audio CD, Wavefield Synthesis, Multichannel Microphone Recording, and Harman Becker Automotive Systems.

Swedish Radio's entertaining demonstration showed how they have been using DTS coding for a number of radio programs, enabling them to "hide" surround bit-streams in conventional broadcasting contribu-

tion and transmission networks without needing to modify those systems very much or at all. SR's website now has numerous DTS-encoded programs available (some with files as large as 480 Mbytes), and remarkably they have had 1.3 million downloads to date, accounting for some 50% of traffic. They are also broadcasting on DVB (digital video broadcasting) and satellite.

A special demonstration was staged on the last day of the conference to compare a number of different microphone arrangements by making recordings in the Banff Centre's Rolston Recital Hall and listening to the replays in a nearby control room. This featured a number of designs including those by DPA, the Holophone (a novel multichannel head-type microphone), Josephson, and the Fox/McGregor modular microphone array.

Panel discussions also took place at strategic points during the conference, enabling issues affecting the future of the busi-

ness to be aired in public by leading voices in the field.

The first, proposed originally by Takeo Yamamoto who was unfortunately unable to attend the conference, looked at "Problems for the Popularization of Surround Sound Systems for Music." Panel members included David Griesinger, George Massenburg, Kimeo Hamasaki, Jean Marie Geijsen, Günther Theile, and Karlheinz Brandenburg. Moderator Wieslaw Woszczyk asked if 5.1 has been successful, and panel members suggested that widening the sweet spot is crucial. Hamasaki also said that it is possible to reproduce a convincingly diffuse field using 5.1 technology, and asked whether it was really necessary to have any more than five loudspeakers. In response Brandenburg suggested that a paradigm shift is already under way because the reality now of adequate DSP at the replay end of the chain enables mapping from source formats to whatever loudspeaker arrangement is present. In consumer equipment automatic equalization and level alignment is becoming a reality. He encouraged people to keep multitrack masters so that they can be reformatted in the future.



Multichannel mixing engineers during one of several 24th roundtable discussions: from left, moderator Geoff Martin, Jim Anderson, Florian Camerer, Akira Fudada, Jean Marie Geijsen, Bob Ludwig, and George Massenburg.



John Sorensen (left), committee vice chair, and Joe Missio, facilities chair, coordinated the daunting logistics and scheduling that produced the smooth-running conference.

Lunch on Friday was an outdoor barbeque with great food, brilliant sunshine, and spectacular views of the Canadian Rockies.



This panel also discussed the center channel in the 5.1 arrangement, which it was claimed need not be sacrosanct—it may be smaller than the other loudspeakers and signal processing may be necessary to compensate for this. There was a general agreement, though, about the importance of the center channel—a fact that was reinforced in a later session chaired by Geoff Martin who took a quick audience poll that turned up only two voters who would dispense with it.

Jean Marie Geijsen pointed out that some correlation is desirable between the channels of a surround balance, otherwise the rear channels don't "disappear" or blend with the front. He took an extreme and amusing example of playing Beethoven in the front channels and Mahler in the rear to illustrate the absurdity of complete decorrelation between channels.

Summarizing what he felt would really sell 5.1-surround music, Geijsen spoke of a 5.1 demonstration in which the spatial envelopment was so overwhelming that it moved many listeners to cry with joy. Geijsen said, "That's the way to sell it."

In questions at the end of the panel discussion, Dave Malham asked if we should be using a stage presentation paradigm as the basis for a format. The panel admitted that 5.1 was not ideal for musicians located all around the listening area, but that this was not particularly common at present. Massenburg, on the other hand, pointed out that he comes originally from the Bluegrass tradition where instruments all around the room are the norm. Griesinger made an important point when he said that it is important to distinguish a standard for recording from a reproduction arrangement (which the recording engineer cannot control). For example, 110-degree video screens are coming and the sound reproduction arrangement may have to adapt correspondingly.

Another panel discussion, chaired by Geoff Martin, took place among mixing engineers on the Friday morning of the conference. The panelists were George Massenburg, Bob Ludwig, Florian Camerer, Jean Marie Geijsen, and Akira Fukada, as well as Jim Anderson who stood in for Michael Bishop on short notice.



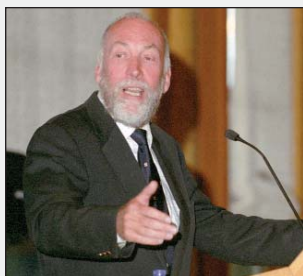
From left: Wieslaw Woszczyk, Morton Stove, Theresa Leonard, and Roger Furness



Mark Wold (left), conference coordinator, and Peter Cook



From left: Fredrik Stålne, Bosse Ternström, Jim Andersen, Peter Cook, and Scott Estersen.



Speakers at Saturday night's closing banquet: clockwise from above left, AES President Kees Immink, Executive Director Roger Furness, and 24th Conference Chair Theresa Leonard.



Cellist Shauna Rolston, one of Canada's most celebrated musicians, performed at the closing concert on Saturday night, accompanied by Lydia Wong on piano.



Ludwig said that he always starts mastering with the 2-channel mix, because if he starts with 5.1 he finds it really difficult to go back to ordinary stereo. Geijsen confirmed that he tends to do the same and that he prefers to have a separate mic setup for the 2-channel recording. Two-channel stereo, he suggested, is always a trade-off between inner detail and room acoustics. Musicians always want both which can't be done, but now 5.1 allows the engineer to separate the room acoustics from the direct sound. He also said that there were often problems with location control rooms if one has to monitor in surround. The virtual room, such as Studer's binaural room-scanning (BRS) system is a reasonable proposition but is not commercially available yet.

As in the early days of stereo, some of the engineers claimed that artists can get carried away with 5.1, leaving the mix engineer to attempt a more controlled mix afterwards. They typically want too much reverberation and other effects that the listener would rapidly tire of. Ludwig stressed that it was imperative to check mixes on a bass-managed replay system; 90 percent of the time mixes translate quite successfully, but occasionally there are problems. Most material he gets to master has LFE content that is unfiltered so it needs checking with low-pass filters included.

CULTURAL AND SOCIAL EVENTS

The chefs at Banff surpassed themselves for the AES, laying on meal after meal of exceptional quality, not to mention Thursday evening's reception at which a remarkable ice sculpture, carved with the AES logo embedded within, was employed to chill martinis for the guests. After a chilled drink at the martini bar, delegates were able to enter the award-winning art installation, *The Paradise Institute*, set up in the Banff Centre's Walter Philips Gallery. The installation, in which viewers sit in two rows of theater seats, is a mock-up of a movie theater with video projection and binaural sound. The scenes involved quickly-changing and unusual images depicting mind interactions between the two main characters. It was Canada's winning entry at the 49th Venice Biennale in 2001. That same evening guests could also listen to percussionist D'Arcy Philip Gray performing David Tudor's "Web II for John Cage" in the Rice Studio. Still later in the evening at the cafe in the Banff Centre's sports complex, David Griesinger performed Schumann's *Dichterliebe*, accompanied by Francis Rumsey on the piano, to a smaller group of listeners.

On Friday night Yamaha sponsored a wonderful reception in the Trans Canada Pavilion. Saturday night's closing banquet was held in the main dining hall, preceded by a stunning cello recital given by Canada's leading cellist, Shauna Rolston. Rolston, accompanied by Lydia Wong (herself an international performer of considerable renown) performed Barber's *Sonata Op. 6*, the outstanding cello solo from Messiaen's *Quartet for the End of Time (Louange a l'Eternité de Jesus)*, Falla's *Suite Populaire Espagnole*, and Popper's virtuosic *Hungarian Rhapsody Op. 68*. Rolston is an incredible cellist, with a range of tone, passion, and beauty rarely heard.

ENCORE?

Great enthusiasm was expressed among all present for another multichannel audio conference in two years time, as this field is evolving rapidly. Delegates present at both the 19th and the 24th Conferences commented on how much progress has been made in just two years, leading all to forecast still greater advances in the next two years. The world of surround sound is alive and kicking, judging by the enthusiasm demonstrated in Banff.