

AES 40th International Conference

8–10 October, 2010
Tokyo, Japan



In the heart of one of the biggest urban agglomerations of the world, Tokyo, Japan, the AES 40th International Conference, *Spatial Audio—Sense the Sound of Space*, attracted over 200 audio engineers, researchers, and students from around the globe. The 40th Conference was arranged at two different locations: on the first day it took place at the NHK Science & Technology Research Laboratories (NHK STRL), and on the second and third days at the Senju Campus of the Tokyo University of the Arts. NHK STRL, the R&D center of future broadcasting technologies belonging to the Japan Broadcasting Corporation (NHK) is located in the Setagaya ward in the southwest of central Tokyo. It offered the place and necessary equipment with its auditorium (facilities for demos and concerts from 5.1 to advanced multichannel), and Super Hi-Vision theater with 22.2 multichannel sound system for the Day 1 program. The Senju Campus of the University of Fine Arts Tokyo is located in Kita-Senju, Adachi ward, in the northern area of central Tokyo. The Department of Musical Creativity and the Environment provides education in music and sound for students in sound engineering and research for musical performance. The auditorium, foyer, and a big recording studio with an adjacent control room were a perfect place for the activities of the first part of the conference. At both locations buffet-style

Spatial Audio

Sense the Sound of Space



lunches and coffee breaks provided an environment for recreation and discussions.

The conference cochairs Kimio Hamasaki and Toru Kamekawa organized a program with three keynote addresses, 38 paper presentations, 14 posters, 11 workshops, and demonstrations where the participants shared and discussed their work on the latest advances in spatial audio. Wiesław Woszczyk, Bike Suzuki, and Ville Pulkki functioned as advisors for the conference.

The paper cochairs Kazuho Ono and Thomas Sporer, along with their reviewing committee, had selected a total of 52 papers dealing with spatial audio and focusing on techniques from conventional channel-based surround setups through object-based setups and soundfield synthesis to binaural listening. The papers covered such topics as spatial audio perception, evaluation, spatial rendering and reproduction, coding, surround sound with height, microphones and mixing techniques, 3-D sound, spatialization and reverberation, application, and monitoring of sur-

round sound.

Kazutsugu Uchimura, Florian Camerer, and Akira Nishimura, workshop cochairs, arranged a program of 11 workshops that dealt with practical applications and research in spatial sound. Topics and demos included periphony, measurement of high-quality room impulse responses in multichannel, tools for spatial sound design in multichannel surround, the current state of 3-D sound, surround music and field recordings, sound field diffusion modeling, new spatial audio coding methods, auditory space perception, and approaches for the spatialization of sound in games.

The Senju Campus of the Tokyo University of the Arts was also the location for an additional preconference workshop chaired by Erisa Sato. Students had the chance to deepen their knowledge about technology and R&D activities in 3-D audio and visual production.

Special events and social venues gave the attendees the opportunity to meet experts and make friends and contacts in a special



Toru Kamekawa (left) and
Kimio Hamasaki, conference
cochairs



Kazuho Ono (left) and
Thomas Sporer, papers
cochairs



AES president
Diemer de Vries (above)
and past president
Jim Anderson



Workshops cochairs: clockwise
from left, Florian Camerer,
Akira Nishimura, and
Kazutsugu Uchimura



40th conference keynote speakers explain spatial audio concepts to delegates:
from left, Yôito Suzuki, Angelo Farina, and Mikako Mizuno.

Japanese, or rather Tokyo, atmosphere.

The hard work of the committee members, volunteers, and members of the AES Japan Student Section made the smooth flow of the rich content and enjoyable events possible and the AES 40th International Conference a great success.

KEYNOTE ADDRESSES

The three keynote addresses were held as starting events on each of the three days. Angelo Farina from the University of Parma, Italy, outlined in his keynote, "History and Current State of the War between the Two Main Approaches to Surround Sound: Discrete Loudspeaker Feeds versus Hierarchical Matrix," the

history of competition or hybridization of the two opposite concepts for creation of surround sound. He described how microphone signals are applied to multiple loudspeakers, starting with the discrete method, over "virtual microphones" by amplitude panning, to the matrix-dematrix approach, such as higher-order ambisonics (HOA), where the number of loudspeakers is not limited to the number of feeds transmitted. Sound samples using various recording methods were presented to the audience.

In the second keynote, "Auditory Displays and Microphone Arrays for Active Listening," Yôiti Suzuki discussed the principles of human spatial audio perception and multimodality and gave an overview of the research dealing with 3-D audio per-

formed at the Tohoku University, Japan. He emphasized the fact that the human being is an active listener and the importance that an auditory display should match the motions of head and body movements as a key for the sense of presence. His overview contained systems aiming at this motion compatibility; among others, he presented a 3-D sound-space recording system consisting of a spherical microphone array (252 capsules) based on “Symmetrical object with ENchased ZIllion” (SENZI) architecture, a high-definition auditory display based on 5th order HOAs and its implementation with a surrounding loudspeaker array of 157 loudspeakers.

Mikako Mizuno from the Nagoya City Museum, summarized in her keynote, “Space and Concept in Contemporary Music,” approaches of contemporary music composers using spatial sound design. Beside a historical review of the use of space in music she focused on the work of “Tekkoku” at the World Exposition held at Osaka, Japan in 1970 by Toru Takemitsu, as well as works of Iannis Xenakis and Luigi Nono and others, including examples realizing spatial musical design in modern architecture.

PERCEPTION AND EVALUATION OF SPATIAL SOUND

Seven papers on spatial perception and evaluation were presented in two sessions on the first and third day. Papers in this session focused on perceptual evaluation and measurement of spatial sound, theoretical or practical approaches for sound reproduction, and perceptual measurement in terms of image localization and spatial impression as well as on timbre and speech intelligibility. Chungeun Kim suggested a spherical head model containing multiple pairs of microphones intended as a capture device to mimic head movements, analyzing the signal outputs of the model in terms of just noticeable differences of interaural time and level differences and interaural correlation coefficient (IACC). The localization of virtual sound sources using head-related transfer functions (HRTF) was the subject of two papers.

Abhishek Guru used, in addition to individualized HRTF, an individualized headphone correction for improved front-back discrimination tests. Kenji Ozawa showed a couple of test results supporting his hypothesis of the efficacy of training on sound image azimuth and elevation localization with nonindividualized HRTFs, which is expected to be interesting for virtual audio display applications. In particular he showed that short training sessions resulted in the persistence of learning efficacy over a month. Localization of phantom sound sources in a multichannel surround system for Ultra-High Definition TV was the subject of Young Wo Lee’s paper, in which he applied a modified vector-based amplitude-panning (VBAP) algorithm.

Researchers in the field of communication technologies dealt with spatial audio in terms of intelligibility and quality in teleconferencing. The evaluation and implementation of transmission and reproduction methods that take advantage of spatial reproduction for intelligibility was realized and evaluated in three papers. The implementation of this key feature was tested by Jukka Ahonen using Directional Audio Coding (DirAC), a method to parameterize the directional soundfield enabling low-bit transmission. Anton Schlesinger presented a method for eval-



Registration on the first day of the conference

uation of speech intelligibility based on binaural speech transmission index and a binaural processing stage (cross-correlation). Alexander Raake showed the importance of audio bandwidth and spatial reproduction in terms of the quality of spatial audio conferencing.

SPATIAL RENDERING AND REPRODUCTION

This session contained papers dealing with theoretical and analytical examinations of soundfield reproduction, new transducer concepts, and reproduction methods for multichannel surround sound and binaural reproduction. A review of the latest research activities in China, given by Bo-Sun Xie, described work dealing with HRTF and virtual audio displays. Approaches for the improvement of soundfield synthesis, such as wavefield synthesis (WFS) or higher-order ambisonics (HOA), were represented in a number of papers at this conference. Noriyoshi Kamado described the benefits of directly-aligned multipoint controlled wavefront synthesis (DMCWS) compared to conventional WFS in terms of spatial spectrum characteristics (spatial aliasing). DMCWS, which is basically a method to control a wavefront on a control line in front of a loudspeaker array, was concluded to have a larger listening area with fewer amplitude and phase errors. Sascha Spors discussed in his paper the use of focal sound sources as virtual secondary sound sources in order to gain a higher spatial density of those sources around the listening area. He showed that synthesized virtual secondary sound sources reveal a higher accuracy above the spatial aliasing frequency. A comparison between WFS and HOA by Jens Ahrens, analyzed in terms of the precedence effect, revealed artifacts in timbre and sense of spaciousness above the spatial alias frequency for WFS and source splitting for HOA. David Moore described a tool for designing ambisonic decoders for 5-channel surround based on a computer search program. Localization tests, performed by Jae-Hyoun Yoo, in 21-channel surround driven by a physical reconstruction of a target 3-D soundfield based on predefined control volume showed a better performance for distance localization compared to VBAP. Svein Berge introduced a frequency-domain parametric method for transcoding first-order B-format signals to a binaural format suppressing different types of artifacts. The application of personalized binaural room impulse responses for three-dimensional virtualization of large spaces like film dubbing stages was presented by Stephen Smith. Two papers dealing with novel methods for

sound transduction were also part of this session. Minsung Cho showed in his paper the characteristics of a novel design of a single panel two gel-type transducer for independent sound source reproduction on the panel. Aiming at easy installation of multichannel systems at home, two types of lightweight transducers using electroactive elastomer (EAE), a soft flexible material, which transforms by applying voltage, were developed and presented by Takehiro Sugimoto.

APPLICATIONS OF SPATIAL AUDIO

The advantages of spatial audio applications in several fields were shown in two papers in this session. Durand Begault gave an insight into NASA Ames Research Center's role in developing improved human-machine interfaces focusing on a combination of hardware and software development, psychoacoustic experimentation, human factors applications research, and communications engineering. Begault described the benefits of spatial audio in NASA-related technologies and gave examples of its application in space operations, aeronautics, and search and rescue. A further field of application was presented by Julian Vilegas, who presented the application of soundscape synthesis using geo-located virtual sources for the use in location-aware announcements in a vehicle.

SURROUND WITH HEIGHT

3-D audio reproduction of sound with height has recently earned increased attention in the audio engineering community. Methods include multichannel systems with elevated loudspeakers, virtual sound sources, and binaural audio. Kentaro Matsui evaluated sound image elevation localization by real sound sources and their binaural representation in anechoic and reverberant conditions, concluding deterioration in the upper hemisphere in the median plane. Sungyoung Kim compared the perception of elevation localization between real sound sources and virtual sound sources of a proposed method using transaural crosstalk cancellation in a 5-channel surround configuration. Jose Lopez evaluated a hybrid system consisting of conventional WFS in combination with HRTF elevation cues, while elevation localization was dependent on the listening position. Using an 8-channel surround sound reproduction system with two loudspeakers placed laterally above the listener and the convolution of anechoic signals by impulse responses of a microphones array, Wieslaw Woszczyk showed dependence of spatial impression (height, immersion, preference) on the nature of overhead signals varied by overhead signals convolved with impulse responses of a dummy head. Hyun Jo tested the performance of candidate sets of HRTF on elevation localization. A review of realization approaches for live sports programs in 22.2 multichannel surround was given by Tsuyoshi Hinata, showing microphone settings, mixing concepts, and work flow in the sound production including figure skating, basketball, and volleyball broadcasts.

SIGNAL PROCESSING AND CODING

The processing and coding of spatial information of sound focuses on transmission band-

width issues, solutions for up- and down-mixing problems, and the aim to be independent from the reproduction system and loudspeaker arrangement by adequate encoding and decoding of sound objects or captured soundfields.

Adrien Daniel described a scheme for encoding multichannel audio based on a psychoacoustic model that returns the minimum audible angle (MAA) in presence of a distracting sound. For the encoding process, Daniel took advantage from the order of truncation of HOA to control a suitable listening area from the perceptual point of view, in this case the MAA. Mark Vinton introduced a new algorithm for up-mixing from two to five channels using a hybrid of scale factor and variable matrix techniques, validating its performance in reproducing the front soundstage in subjective tests. Oliver Thiergart proposed a method for directional audio coding (DirAC) based on adaptive parameter estimators for three-dimensional soundfield analysis. He explained that his method increases the parameter accuracy by considering signal-to-noise ratio (SNR) and stationarity interval of the input.

MICROPHONE AND MIXING TECHNIQUES

In this session, two papers of research on soundfield capturing were presented. A comparison of two sound extrapolation methods for the measurement of soundfields of WFS or ambisonic sound systems was performed by Philippe-Aubert Gauthier. In terms of identifying methods that can accommodate various nonuniform sensor arrays, he concluded that the Tikhonov regularization is less sensitive to measurement noise. Angelo Farina, who had already referred to this paper in his keynote address, described a new mathematical theory and its implementation in a multichannel recording system based on a 32-capsule spherical microphone array, which can simulate up to 7 virtual microphones in real-time and change its aiming and directivity pattern from omni through cardioid to 6th-order ultradirective. He obtained the virtual microphones by processing the 32 channels from the spherical array by digital filters derived from impulse response measurements for each direction of arrival. Farina also presented the hardware and an interface for application in sound production raising his expectations that this system could be a revolutionary approach for sound capture in sound production in the future.



Delegates discuss poster presentations with authors.

SPATIALIZATION AND REVERBERATION

The recent increase in 3-D sound reproduction methods is raising the needs and possibilities for new spatialization and reverberation approaches. Fritz Menzer introduced a reverberation structure for binaural reverberation, where reflections and late reverberation are modeled by separately used and highly overlapping feedback delay networks (FDN). Menzer realized a reduction of computational complexity by applying HRTFs only on the first-order reflections. Yakashi Nishi presented his work dealing with the creation of binaural impulse responses while controlling parameters such as reverberation time, C80, and IACC. An impulse-response-based tool for 22.2 multichannel ambiance design, named the Space Builder, was introduced by Wieslaw Woszczyk. It consists of a system that uses low-latency convolution of segments from multichannel room impulse responses in high resolution (24 bit/96 kHz) and a graphical user interface (GUI) for spatial design, providing a spatial up-conversion from one to 24 channels. This system was also part of a workshop at this conference, dealing with the capturing and temporal segmentation of high-resolution impulse responses. Juha Vikamo proposed a frequency transform domain reverberator considering perceptually-relevant properties of reverberation. The reverberator consists of a feedback loop and a sparse multiplication-free decorrelator, aiming for computational efficiency. Frank Melchior described the concept and implementation of a reproduction-system-independent room simulation on the basis of circular array measurements of high spatial resolution impulse responses. He combined in a GUI the static and dynamic interactions enabling spatial sound design by controlling direction-dependent level of early reflections.

MEASUREMENT AND ANALYSIS OF 3-D SOUND

Toshiyuki Kimura presented a numerical analysis of 3-D soundfield reproduction simulating the virtual boundary surface of an array of directional microphones by a loudspeaker array placed beyond the surface. He proposed a boundary-surface control method using inverse filters and the acoustic transfer function showing a more accurate reproduction of wavefronts compared to conventional systems in terms of a lower SNR. For nearfield HRTF and binaural measurements using a KEMAR dummy head, Guang-Zheng Yu developed a spherical dodecahedron sound source as an approximate point source, showing that HRTFs are significantly different for distances up to 0.5 m, and that interaural level differences were varying with distance of the sound source but ITD did not. Hiroshi Koide presented a measurement technique for a tetrahedron microphone arrangement by inverse time-stretched pulse (TSP) filters without synchronizing the sound source and the receiving measurement device. He proposed for this asynchronous measurement method a synchronous averaging in the frequency domain for inverse TSP filtering and tested this method for real and virtual sources.

POSTERS

Fourteen presentations were part of the poster session, held on the second day at the Senju-Campus of the Tokyo University of the Arts. The presentations dealt with a wide range of topics: elicitation of spatial impression attributes and their relation to physical factors for surround recording evaluation; proposals for the development of a multichannel-compatible perceptual eval-

uation of audio quality (PEAQ) algorithm extraction of virtually-placed microphone signals out of far-positioned microphone signals; improved ITD estimation in reverberant environments; reconstruction of wavefronts using the spatial covariance matrix; inverse wave propagation in WFS; soundfield equalization by active control of sound pressure and particle velocities; enhancement of stereo recordings by modifying the stereo distribution over the panorama of a stereo mix according to a nonlinear warping function; soundfield reproduction based on reproduction error minimization at a microphone array; a comparison of different coincident microphone settings for teleconferencing using DirAC; results of a real-time estimation of directions of speech based on ITD for application in telecommunication between two augmented-reality audio users; an investigation of intelligibility degradation of speech by two audio coding methods; a multiloudspeaker test system providing the ability to measure a loudspeaker's position in azimuth, elevation, distance, and magnitude response; and the sound design, implementation, and evaluation of a PDA game in terms of spatialized audio.

WORKSHOPS

Earning the same attention as the papers from the conference attendees, the workshops were a good chance to get an insight into recent activities in spatial audio research and applications, and a chance to experience sound reproduction, recording, and mixing techniques and demonstrations.

Wieslaw Woszczyk chaired the workshop "Measuring High-



One of the workshops on multichannel sound was held in Studio A at Tokyo University of the Arts.



Akira Fukada demonstrates surround mixing of jazz.



A packed workshop in an NHK's studio



There was plenty of time for informal discussions outside the NHK STRL building.

Quality Room Impulse Responses for Artistic Applications,” in which measuring technology of the impulse response of various-type rooms were discussed and several applications using measured impulse responses were introduced. Woszczyk and Kimio Hamasaki then chaired the workshop “Space Builder: A Comprehensive Production Tool for 22.2 Channel Sound Design,” in which an advanced tool for creating three-dimensional sound space using a 22.2 multichannel sound system was introduced. The tool includes 3-D spatialization based on the convolution and temporal segmentation of impulse responses captured in multichannel. The separation into early, mid, and late segments allows independent control and the combination of responses from different rooms providing artistic freedom for spatial design in sound productions. Sound clips of both classical and pop music, recorded by Richard King and George Massenburg using the space builder, were also demonstrated.

Jeff Levison chaired the workshop “Periphony—More than Just Over Your Head,” in which scientific research, classical recordings, pop music production, audio drama, expanded cinema, and theatrical stage sound design were discussed and playback examples were presented concerning surround with height. Wieslaw Woszczyk emphasized the importance of height information in three-dimensional sound for perception of immersiveness and presence. Stuart Bowling demonstrated 7.1-channel sound used in games and discussed an emerging trend of multichannel sound in cinemas. Ulrike Schwarz presented the background and artistic philosophy of surround music production performed at Bayerischer Rundfunk (BR), where 5.0 recordings are always accompanied by a separate two-channel mix. Schwarz also presented an experimental recording sample using

height microphones for upper front and back loudspeakers. Wilfried Van Baelen presented the recent developments at Galaxy Studios regarding the introduction of a complete new format for channel-based 3-D audio, calling it Auro 3-D, which consists in its smallest version of conventional 5.1-channel plus four additional upper loudspeakers (9.1 channels) and for bigger versions up to 13.1 channels. The attendees could compare listening examples including a piece by the “loudest rock band on earth,” passing bikes, airplanes, and field recordings produced by Galaxy with and without the upper-layer channels. Helmut Wittek from Schoeps gave an introduction into the principles in the design of a surround microphone with height and presented recording demonstrations using the OCT-7 microphone. Jeff Levison showed some of his work in acoustic art design in theaters and in sound installations, such as using hanging loudspeakers from the ceiling in a theater. The concept of a 22.2 multichannel sound system was introduced by Kimio Hamasaki with several sound demos including the newest recording of “Gruppen” by Karlheinz Stockhausen in which three orchestras were placed in front, left, and right positions.

Led by the papers cochairs Kazuho Ono and Thomas Sporer, a fourth workshop dealt with the current state of 3-D sound technologies. Diemer de Vries gave an overview of the development in research of WFS from its beginnings to today, where WFS and its possibilities are recognized by the audio community but not applied for mass production. De Vries asked the unresolved question how to proceed in the application of WFS. Frank Melchior of Iosono talked about the principles and types of WFS applications, discussing channel-based versus object-based approaches. Considering perceptual and system-related goals, Melchior gave examples of object-based spatial audio techniques, implying advantages in flexibility and compatibility between reproduction formats. Sascha Spors of Deutsche Telekom worked out the differences between WFS and nearfield-compensated HOA (NFC-HOA) as two well-known approaches aiming at physical soundfield synthesis (SFS). He concluded that the spatial band limitation is a major difference between NFC-HOA and WFS and that there is still need for psychoacoustic research on both approaches. Shiro Ise from Kyoto University presented research on a 3-D sound reproduction system based on boundary surface control for high-presence communication applications with “soundfield sharing.” The system includes a seat in an enclosure where loudspeakers are placed on a dome-shaped ceiling surrounding the listener. Toshiyuki Kimura presented a sound reproduction approach aiming “ultra realistic” communication with a view to “real 3-D television,” where someone can observe objects from all positions around an audio-visual display. Kimio Hamasaki presented his work on a system called “Advanced Multichannel Live Sound Field Reproduction System.” An experiment was performed transmitting the sound of an orchestra in a concert hall to another hall. The hall was equipped with multiple loudspeakers positioned in front of an audience graduated in depth for reproduction of direct captured sounds of the instrument groups and surrounded by loudspeakers for ambient sound reproduction revealing a high sense of presence for the audience. A demo of this system could be experienced on the first day at STRL. Kazuho Ono summarized his research on loudspeaker arrays for distance perception control and spatialization. Thomas Sporer spoke about



The conference chairs and delegates enjoy an excellent banquet.



Tokyo at night as seen from the boat on which the banquet was held.



Delegates enjoy a buffet dinner at NHK.



Traditional Japanese dance performance at the welcome concert.



40th Conference committee and volunteers: from left, back row, Kazuho Ono, Bike Suzuki, Kazutsugu Uchimura, Toru Kamekawa, Kimio Hamasaki, Osamu Nakagawara, Shinichi Kita, and Toru Futatsugi; front row, Atsushi Marui, Masayuki Mimura, Akira Nishimura, Kazuya Taniguchi, Masataka Nakahara, and Masayoshi Kurosawa.

issues relating to a generic file format for spatial audio, discussing its requirements on simplicity, flexibility, and portability. He proposed replacing the channel-based approach with an object-based paradigm having metadata including position of loudspeakers or objects.

Attendees interested in surround recordings could experience the design and recording of a jazz trio performance in a practical workshop from the perspective of a sound engineer, given by Akira Fukada from NHK. The band consisting of Aaron Choulai (piano), Yasushi Fukumori (drums), and Akiyoshi Shimizu (bass) gave a high-level performance in the recording studio of the Tokyo University of the Arts, while the workshop attendees could move freely between the studio, a separate listening room, and the control room where Fukada discussed the recording with the musicians. As an additional feature, microphones capturing height information from the studio were played back in 5.1 in four upper loudspeakers.

Toshiyuki Hanyu of Nihon University presented a new theoretical model for quantitatively characterizing soundfield diffusion based on scattering coefficient and absorption coefficient of walls.

Florian Camerer of ORF, Austria, presented the work of Sabine Maier dealing with the question of how far the audio perspective should follow the video angle in classical music recordings for television. Maier created mixes in 5.0 and two-channel stereo from the Neujahrs Konzert at the Wiener Musikvereinssaal in cooperation with Camerer, adjusting the parameters panorama or/and level adequately to the video picture, which included the change of the parameters per editorial cut between the 13 different viewing angles. The results of a listening test showed that level adjustments were accepted while panorama changes alone were not.

As follow-up of a workshop on the first day, Wilfried Van Baelen continued the presentation about the practical and technical issues for bringing spatial audio formats to the market. Discussing the specific requirements on the production and consumer side, Van Baelen presented a unique production tool for spatial audio mixing and mastering and a codec for discrete 3-D (2-D) sound including an upmix and downmix algorithm for compatibility between 5.1 to 9.1 (5.1 to 2.0) loudspeaker setups.

"The Art and Practice of Multichannel Field Recording" was a workshop chaired by Charles Fox, in which he and panelists Mick Sawaguchi, Florian Camerer, and Yasuo Hijikata gave impressive demonstrations of field recordings captured in surround made at locations all over the world. The requirements and realization of different surround microphone setups and arrays were discussed and demo samples were played back for comparison.

Ville Pulkki chaired the workshop "New Spatial Audio Coding Methods Based on Time-Frequency Processing." Pulkki introduced the psychoacoustical aspects of time-frequency hearing of spatial sound and showed that the spatial resolution of audio can be compromised heavily when human mechanisms are taken into account. Pulkki and panelists Jean-Marc Jot and Juha Vilkkamo described and demonstrated the main applications: stereo-to-5.1 upmix, multichannel coding, and spatial sound reproduction.

David Griesinger discussed the importance of the direct-to-reverberant ratio in the perception of spatial impression attributes and clarity and presented an amplitude-modulation-based basilar

membrane model in combination with a pitch-detection model showing the neural patterns of binaural-captured sound presented in this session.

The final workshop dealt with the spatial sound design approaches used in computer games. Chaired by Steve Martz and Kazutaka Someya with panelists Kanako Kakino, Tetsukazu Nakanishi, Masayuki Sato, Atsushi Suganuma, and Kazuya Takimoto—all of whom are involved in sound design for major computer game companies—presented the requirements for audio spatialization in game sound design and gave examples for solutions. Methods for real-time and offline rendering were presented and sound sample demonstrations gave an insight into the efforts in spatialized sound for creating a sense of reality.

SPECIAL EVENTS AND DEMOS

On the first day at NHK STRL, attendees had the chance to listen to a demonstration of the Advanced Multichannel Live Sound Field Reproduction System mentioned earlier. Recordings of a symphony orchestra could be experienced, in which the sense of depth and perspective were given for each listening position, revealing an interesting effect when walking between the loudspeakers on the stage. An impressive presentation of Super Hi-Vision video and 22.2 multichannel sound showed the mystery story of the traditional Japanese "Onibashira Matsuri" festival. The first day was rounded off with a welcome concert. The program consisted of a rare Bugaku-style "Gagaku," Japanese ancient court music and dance performance called "Ran-Ryou-Ou," and a contemporary music concert of the "New York Counterpoint" by Steve Reich with live clarinet played against prerecorded parts in multichannel sound by Ikuko Suzuki.

In the studio of Tokyo University of the Arts, a "surround-scape lunchtime concert" was performed by Shiro Murakami (composition/piano) and Mick Sawaguchi (field recording) providing a peaceful atmosphere through the combination of selected nature soundscapes and piano performance.

The dinner cruise with banquet was the social highlight of the conference. After enduring a cloudburst before boarding, guests were sitting in the warm environment of one of two Japanese houseboats, "Yakatabune," forgetting the cold rain while cruising the Sumida River into Tokyo Bay. Everyone enjoyed the Tokyo skyline while having a dinner of various Japanese delicacies (such as Tempura, Sashimi, Nabe) and beverages (sake, shochu, beer) and listening to artistic Karaoke performances, with the highlight being Bike Suzuki singing Japanese Enka songs.

Diemer de Vries spoke in his president's address about the activities of AES, saying that the number of attendees at the 40th Conference was one of the largest of any AES international conferences. The conference was closed by AES past president Jim Anderson, who thanked everyone who had contributed to making the conference such a huge success. Additional support was provided by the conference sponsors: Fairlight, Ballad, DTS Digital Entertainment, Electori Co. Ltd, Foster, Fujitsu Ten, Nittobo Acoustic Engineering Co. Ltd, Otari-tec, Pioneer, Panasonic, Rock On Pro, Sanken, Sona, Tac Systems, and THX.

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