

# 48<sup>th</sup> International Conference Automotive Audio



Jan Abildgaard Pedersen,  
Conference chair

Schloss Hohenkammer  
Munich, Germany

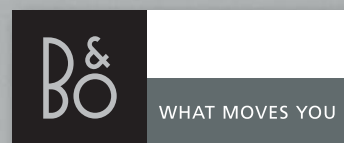
21–23 September 2012

## CONFERENCE REPORT

The 48th AES International Conference on Automotive Audio was held near Munich in Germany in late September 2012. This conference was a follow-up to the AES 36th in 2009, which also focused on audio in cars. Over the last 20 to 30 years, automotive audio has changed dramatically from being standard mono sound in one full-range loudspeaker to a true multichannel playback system fully integrated and adjusted to the specific car. Today some of the most advanced sound technology is being developed and applied in automotive audio.

The designer of an automotive sound system is challenged by numerous physical factors such as inadequate loudspeaker locations, limited space for the system integration, a significant level of background noise, and music that is produced for a listening room. However, many people today spend more time listening to music while driving than in their homes, so an increased demand for high-quality audio reproduction has emerged for cars. Multiple sweet spots in the passenger compartment are needed together with a number of convenience features, such as driving noise compensations that can provide entertainment without jeopardizing safety.





The conference lecture hall

The scientific level of AES 48th proved to be very high, and the high number of participants (132 persons) clearly showed that this technology area is now matured with a large group of true experts and researchers in the field. The conference offered one keynote address, 17 high-level scientific paper presentations, four workshops with 20 panelists, six demo cars, two demo rooms, four tabletop demos, high-quality professional networking, and social events. The conference was a three-day fully residential event held at the Schloss Hohenkammer Conference Center, which had all the necessary facilities to serve the delegates during the event. One-hundred-thirty-two participants from 13 countries around the world traveled to this lovely area of Bavaria in the southern part of Germany.

Conference Chair Jan Abildgaard Pedersen of Bang & Olufsen and his committee assembled a conference program that presented an overview of the current state-of-the-art with a broad perspective and addressed many of the scientific disciplines involved in this important technology field. The papers cochairs, Tim Nind of Harman Becker and Morten Lydolf of Bang & Olufsen, coordinated the technical program of the 17 paper presentations into six sessions. The four workshops were planned and coordinated by Thomas Sporer of Fraunhofer IDMT.

## OPENING AND KEYNOTE



Jan Abildgaard Pedersen, conference chair and AES president, opens the 48th International Conference.

The conference was opened on Friday the 21st of September by Jan Abildgaard Pedersen, who welcomed everyone to Munich and expressed his happiness at seeing so many people at the conference, representing no less than 13 different countries. He pointed out that it takes approximately two years of planning and preparation to

organize an AES International Conference, which led him to introduce his organizing committee: Tim Nind and Morten Lydolf (papers cochairs), Thomas Sporer (workshop chair), Alan Trevena (secretary), Markus Koch (facilities chair), Richard Stroud (treasurer), Russell Mason (webmaster), Tom Nousaine (PR+marketing), and Tyler Walker (sponsorship).

Jan Abildgaard Pedersen then introduced everyone to the conference program by showing details of all the main elements of the conference. Finally he introduced the president of the Audio Engineering Society, who at the time happened also to be himself. Pedersen thanked everyone for participating in this AES conference, and he pointed out how important the international conferences are as a means for increasing the scientific level of the AES and for introducing it to new potential members in different technology areas.

The keynote address was given by Tom Nousaine of Sound and Vision Publication—a key person in communicating the development of automotive audio to the world. Nousaine talked about how reviewers of cars often do not thoroughly test the audio system. Often only the number of watts and number of loudspeakers are reported, but that does not tell you much about the audio quality. Nousaine continued to report that uneven bass is the most frequently found tonal problem. Near side localization bias and ambience and reverberation



Tom Nousaine gives the keynote address.

masking are the typical spatial problems, but also issues relating to dynamics, compression, and distortion are typical problems in cars. Thomas Sporer asked Tom Nousaine if he ever went back to test old systems to check if a score of 4.0 today is the same as 4.0 was five years ago. Nousaine told him that he never tried this.

## DAY ONE

The first paper session was entitled “Perception and Psychoacoustics,” in which the first paper was given by Stefan Irrgang of Klippel GmbH about “In-Situ Detection of Defects in Car Audio Systems.” Stefan explained how the sound quality in cars is rising, expectations of customers are high, and a higher number of speakers are installed in each car. Better bass reproduction features prominently in requests from customers. The presented system offers both detection of defects and a root-cause analysis.

Todd Welti of Harman International Industries continued with a paper entitled “Validation of the Binaural Room Scanning Method Using Subjective Ratings of Spatial Attributes.” This paper described how a dummy head with a stepping motor was used to perform recordings of the reproduced music signal at ten-degree intervals. This enabled listening tests using headphones and a head tracker.

The next point on the agenda was a comprehensive demo session, which offered six demo cars with the newest technology including concepts that are not introduced in the market yet. This included 3-D sound, new automatic EQ, and wavefield synthesis using 62 loudspeakers. The two-and-a-half hour long demo session also included two demo rooms and four table top demos.

The demo session was followed by a workshop, “Communication Systems for Cars,” chaired by Thomas Sporer of Fraunhofer IDMT. In this event Thomas Sporer managed to do the full workshop all by himself, with the conclusion that communication in cars is important and that hand-held phone calls while driving are dangerous. Technology for hands-free phones is natural and provides good quality. Devices must be easy to use and reasonably priced. Speech quality will increase in the next few years and additional features will need more and better audio interfaces.

The first day of the conference concluded with dinner and a social event, where parts of the famous “Oktoberfest” were presented to the conference participants.



Todd Welti speaks on binaural room scanning.



Thomas Sporer, workshops chair, holds forth during a workshop on communications systems for cars.





Six demonstration cars containing the latest in audio technology were parked outside the venue for delegates to discover on the first day.



## DAY TWO

The second day of the conference started with the workshop on “Engine Sound Enhancement,” which was chaired by Sandra Brix of Fraunhofer IDMT. Christoph Meier, Rolf Schirmacher, Andreas Franck, Thorsten Heinz, and Stefan Kolbe formed the expert panel in the workshop. The title of the presentations they delivered were: “Electric Drive Acoustics—Noise Reduction and Sound Design,” “Active Noise Control and Active Sound Design,” “What Can Sound Synthesis Research Do for Engine Sound Enhancement?” “The Importance of Sound for Quiet Vehicles,” and “How e-Cars Will Change Our Business.” The conclusion was that “we have to define the traditional sound of an electric car.”

The second paper session was entitled “System Architecture and Hardware—Part 1,” and the first paper, “Adaptive Identification of Nonlinear Models Using Orthogonal Nonlinear Functions” was



Demo rooms added to the line-up of attractions for conference visitors, including table-top (upper left), Oxford Digital (upper right) and Bang & Olufsen Automotive (lower center)

given by Michele Gasparini from Universita Politecnica delle Marche. Michele presented information on dynamic convolution and diagonal volterra series, and how they can be applied to modeling loud-speaker drive units.

Next Patrick Hegarty of Bang & Olufsen continued with the paper “Room Gain in a Car.” The concept of room gain was earlier introduced and defined by Jan Abildgaard Pedersen in domestic living rooms while Patrick Hegarty presented an investigation of how and if the concept of room gain can be utilized in a car.

The third paper in this session was “Controlling the Direction of Sound Intensity Based on Sound Intensity Transfer Path Analysis,” which was presented by Yosuke Tanabe from Hitachi America. Yosuke first defined sound intensity and then went on by introducing “monopole sound intensity” and “interference sound intensity.”

Lunch was followed by the session “System Architecture and



Yosuke Tanabe deals with the topic of sound intensity.

Hardware—Part 2.” The first paper in this session was presented by Niels Iversen and Thomas Birch from the Technical University of Denmark and the title was “Utilization of Nonlinear Converters for Audio Amplification.” Niels and Thomas explained how Class D amplifiers are well suited for automotive audio and went on by introducing a nonlinear power converter.

The final paper was “Minimizing Crosstalk in Self Oscillating Switch Mode Audio Power Amplifiers,” which was presented by Rasmus Overgaard, also from the Technical University of Denmark. Rasmus showed how crosstalk can be suppressed by 30 dB in self-oscillating amplifiers by using the presented method to minimize the crosstalk.

Workshop 3, “Audio Quality in Production and Long Term,” was chaired by Steve Hutt of Equity Sound Investments. The workshop panel included Edgar Kirk, Alan Trevena, Michael Fabry, Johannes Nowak, Stefan Irrgang, Alfred Svobodnik, and Markus Koch. They gave these presentations: “What Quality Problems Do We See,” “Accelerated Life Test,” “We Tune with 1 dB Tolerance—but Experience 10 dB in Production Tolerances,” “Microphone Array Test of Wave Field Synthesis,” “Up to 30 dB Change due to Environmental Changes,” “Simulation and Modelling,” and “Car to Car Differences.” In the discussion, one of the suggestions by Edgar Kirk was “Why store tuning parameters in the head unit? Why not have an abstraction layer between the head unit and the amplifier?”

The final paper session on Day 2 was entitled “Dynamic Audio Reproduction in Cars” and the first paper was presented by Markus Christoph from Harman/Becker Automotive Systems. The paper was “Noise Dependent Equalization Control,” in which Markus explained how the introduced DEC (Dynamic Equalization Control) algorithm tries to hold the subjective spectral shape constant.

The next paper was “Active Road Noise Reduction in Audi A8 W12 with Adaptive Suspension: A Feasibility Study,” presented by Lars G. Johansen from Aarhus University. Lars gave an analysis of the coherence between accelerometers mounted near the wheels and sound pressure in the car cabin.

Then Jay Kirsch from Harman International presented the paper “Stability Determination for Engine Order Control.” Jay explained how instability of the adaptive filter in an active-noise-cancellation system can be detected in real time.

The time arrived for the delegates to relax, enjoy, and expand their professional network. This was done during the banquet, which included a gourmet dinner with fine wines. The banquet also included a speech by Jan Abildgaard Pedersen, who spoke about the importance of the AES international conferences and how the AES is now changing for the better.



Workshop 3 panel discusses audio quality in production.

## DAY THREE

The final day of the conference started with the paper session “Audio Reproduction in Cars—Part 1.” The first paper, “Acoustical Zone Reproduction for Car Interiors Using an MIMO MSE Framework” was presented by Simon Berthilsson from Uppsala University. Simon discussed a system for generating sound zones in a car by optimizing digital filters for each loudspeaker.

Then Christoph Sladeczek of Fraunhofer IDMT presented a paper on “Wave Field Synthesis-Based Concept Car for High-Quality Automotive Sound.” Christoph described how a concept car with 62 loudspeakers had been built and how the wavefield synthesis system was designed.

Steve Hutt from Equity Sound Investments then presented the paper “Audio System Variance in Production Vehicles.” Steve explained how the quality control of an automotive audio system is centered around the components, not the system performance. He thinks the major root cause for variance in the system is the loudspeaker drive units.

Workshop 4, “Hybrid Radio in Cars,” was chaired by Ralf Hinz of Daimler. The workshop panel included Axel Horndasch, Christoph Dosch, and Daniel Sonner. They made presentations about “Overview of Hybrid Audio Possibilities,” “Enhanced In-Car Experience,” “DAB Minimal Set,” and “Suppression of Electromagnetic Interference.”

The final paper session of the conference, “Audio Reproduction in Cars—Part 2,” began with the paper “Multipoint Equalization for Car Audio Systems,” presented by Michele Gasparini from Università Politecnica delle Marche. Michele reported on a system for equalizing the sound system in a car based on multiple microphone positions.

Then Stig Kleiven from A2Zound presented the paper “Local Sound Separation in Cars,” which describes how sound zones in a car can be designed by the use of remotely located acoustic sources. Stig also presented an interior acoustic simulation model, which was used to develop the designed system.

Johannes Nowak from Fraunhofer IDMT presented “Sound Field Reproduction Analysis in a Car Cabin Based on Microphone Array Measurements,” in which he discusses an analysis of the sound pressure inside a car equipped with a wavefield synthesis system with 62 loudspeakers. The analysis was based on measurements performed with a microphone array.

The final paper was given by Adrian Celestinos, entitled “Car Interior Simulation Model for Low Frequencies Using the Finite Difference Time Domain Method.” Adrian presented a simulation model based on the finite difference time domain method, which provided results that were very similar to the measured sound pressures in a car.

The conference was closed by Conference Chair Jan Abildgaard Pedersen, who thanked his organizing committee, the keynote speaker, the workshop panelists, all the authors, the sponsors, AES headquarters, the exhibitors, and all the delegates for contributing to make the 48th a very successful conference.



Steve Hutt discusses quality control of loudspeakers.

Editor's note: The conference proceedings are available for purchase both as a book and for download online at <http://www.aes.org/publications/conferences/>.



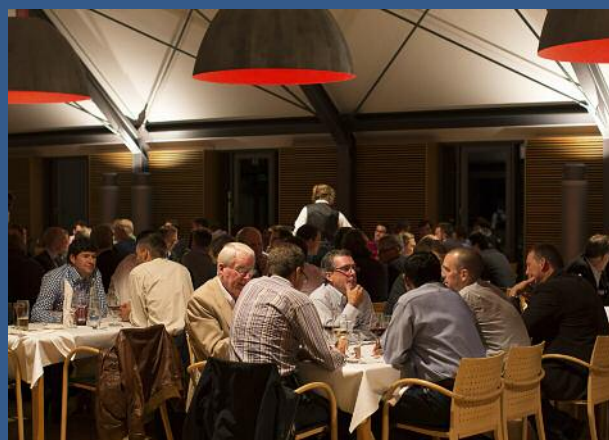


AES 48th Conference committee, from the left: Tim Nind, Alan Trevena, Tom Nounsaine, Morten Lydolf, Thomas Sporer, Markus Koch, and Jan Abildgaard Pedersen. Not shown: Russell Mason and Tyler Walker.

## SOCIAL EVENTS



Pedersen addresses the conference during the banquet.



Delegates enjoy opportunities for professional networking and socializing during the various relaxation periods.