



Fraunhofer

IDMT

Fraunhofer Institute for Digital Media Technology IDMT



1 Loudspeakers mounted into the doors of the Audi Q7 prototype used for Wave Field Synthesis reproduction.

2 Additional loudspeakers mounted into the D-pillar used for Wave Field Synthesis reproduction.

Fraunhofer Institute for Digital Media Technology IDMT

Ehrenbergstr. 31
98693 Ilmenau
Germany

Contact

Christoph Sladeczek
Phone +49 3677 467-388
christoph.sladeczek@idmt.fraunhofer.de

www.idmt.fraunhofer.de

Audi Sound Concept

In the summer of 2010 AUDI and Fraunhofer IDMT presented "Audi Sound Concept", involving the first car ever to be equipped with a fully integrated spatial sound system based on Wave Field Synthesis technology. Coming as a mass produced car in terms of its outer appearance, the Audi Q7 prototype on the inside is a rolling hi-fi studio that makes for an outstanding sound experience.

Challenges

The aim of the "AUDI Sound Concept" project was to build a prototype integrating a spatial sound system based on Wave Field Synthesis technology in a mass produced car. Particular challenges were to

- integrate a large number of loudspeakers in an aesthetic fashion,
- develop efficient signal processing algorithms to leverage Wave Field Synthesis technology in a car,

- develop an intuitive user concept for convenient control and design of sound scenes,
- integrate an interface that allows users to play conventional audio formats, such as stereo or 5.1 surround sound material,
- develop and integrate a concept for close-to-reality, dynamic room acoustics simulation in order to be able to manipulate the car's interior acoustics.

Technical Solution

System Components

- 62 loudspeakers,
- 19" rack industrial PC for loudspeaker signal computing,
- 64-channel Class-D audio amplifier for distribution of audio signals to the speakers,
- DVD audio/Blu-ray player for playing conventional audio formats.

“We appreciate our collaboration with Fraunhofer IDMT, our longtime competent and reliable research partner. Working together in the “AUDI Sound Concept” project we managed to jointly develop the most impressive sound system that has ever been built into a car.”

Peter Gleim, sound/acoustics development, AUDI AG

Loudspeaker Concept

The interior of the Audi Q7 is equipped with 62 speakers in total:

- 52 mid-range speakers to produce the Wave Field Synthesis effect,
- 5 tweeters and 4 woofers to extend the frequency range,
- 1 subwoofer.

User Interface

The sound system can be controlled over an iPad, a tablet PC, or the on-board MultiMedia Interface (MMI). A graphical user interface adapted to the system allows the user to conveniently

- visualize and switch between virtual rooms,
- visualize and position the virtual sound sources,
- display the speaker levels,
- configure the sound.

Replay formats

The sound system allows to play audio material particularly created for being used with Wave Field Synthesis technology.

Different sound objects (instruments, radio announcers etc.) can be positioned and arranged at will in the car’s interior, and the different characteristics of these objects (volume level etc.) can be modified interactively. Besides Wave Field Synthesis material the system also plays conventional audio material (such as stereo or 5.1 surround sound) in the best sound quality.

Room Acoustics Simulation

One special feature of the sound system is its capability to simulate specific room acoustics in the car’s interior. Basically any room characteristics can be simulated – be it an opera house or a nave. By means of efficient signal processing algorithms as many as 16 virtual sound sources can be positioned and arranged in realtime, with room acoustics automatically adapting to the movements of the sound source.



Audi
Vorsprung durch Technik



- | | | |
|-------------|----|--|
| Tweeter: | 5 | |
| Midrange: | 52 | |
| Woofer: | 4 | |
| Sub Woofer: | 1 | |