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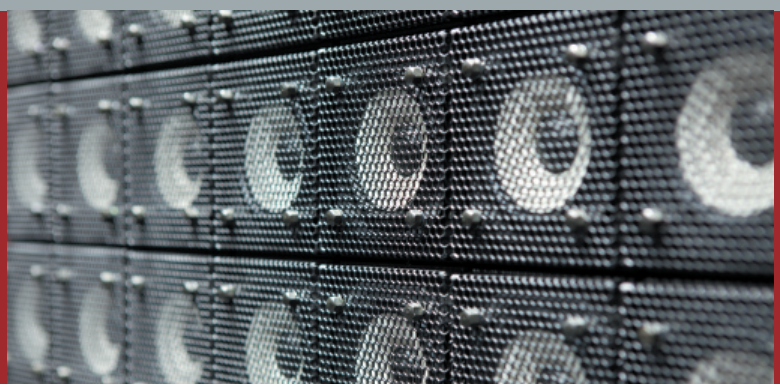

Wave Field Synthesis

When conventional loudspeaker systems are used for sound reproduction in rooms or open venues, optimal sound quality can be guaranteed only for a limited number of seats or a certain section of the venue, respectively (the so-called sweet spot). Sound is not optimally reproduced also if loudspeakers are not adequately positioned.

By means of wave field synthesis technology, which was invented by the Delft University of Technology, The Netherlands, and developed further by Fraunhofer IDMT for full market maturity, a true-to-life sound impression can be created across the entire venue, so that each listener can fully immerse into the sound and enjoy a great sound experience.

Technological Background

The origins of wave field synthesis date back to the 17th century, when Christiaan Huygens came up with the principle of wave propagation. Applying this principle to the field of sound reproduction, it is possible to very realistically imitate the sound field produced by sound sources by means of loudspeaker arrays that are arranged around the entire venue. For each single loudspeaker an individual signal is calculated.

These signals are then superimposed in order to create the sound field of a virtual sound source, allowing to exactly reproduce both point sources and plane wavefronts. Besides providing a synthesis of "dry" sound sources that have no room information, it is also possible to reproduce all kinds of (complex) room acoustics or use virtual sound sources in simulated rooms.

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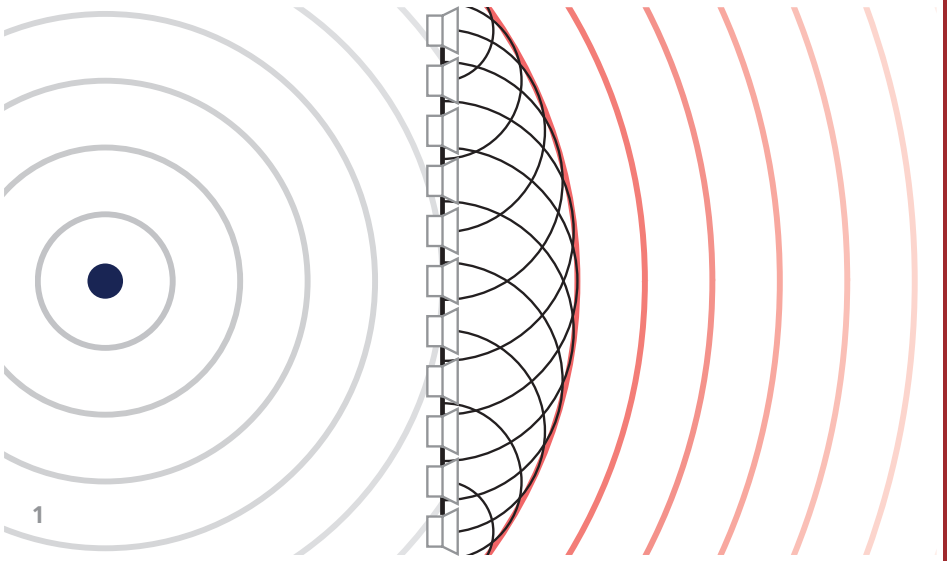

Practical Application

The sound sources' volume levels, positions, and distances are recorded separately from the room's sound characteristics, allowing to manipulate both the individual sound sources and the room's characteristics independently of one another. Other than with conventional sound reproduction technology (such as stereo sound or 5.1 surround sound) the direction and distance of individual sound sources can be reproduced very accurately. Even virtual sound sources can be positioned between the real loudspeaker array and the listener (so-called "focussed" sound sources that are placed directly into the audience), adding a whole range of entirely new options to the creation of spatial sound productions.

For saving and transferring audio objects as well as their characteristics, position, and room information, the 3D audio profile of the MPEG-4 standard can be used. MPEG-4 currently is the most efficient format for high-quality object oriented coding of audio data. Using state-of-the-art computing technology, multiple virtual sound sources can easily be calculated simultaneously also for large loudspeaker setups consisting of hundreds of units. Loudspeaker signals are produced in real-time, with the number and position of loudspeaker arrays being variable depending on the venue given. The individual characteristics of the virtual sound sources (such as volume level or position) can be manipulated interactively.

Compatible Sound Reproduction

Discretely mixed audio productions too can be reproduced at the highest quality by means of wave field synthesis. Used as virtual sound sources, loudspeakers are placed outside the real room at normed positions specified for the respective audio format. Unlike real stereo sound or 5.1 surround sound loudspeaker setups, the virtual setups can be manipulated interactively and adapted to the size of the venue, creating both stable, direction adequate sound reproduction for different listening positions and an improved spatial sound impression all over the place.

1 *The signals for the loudspeaker arrays are calculated by the wave field synthesis algorithm. The sound waves are then superimposed, creating the wavefront of a virtual sound source.*