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A virtual auditory environment for investigating the auditory signal processing of realistic sounds

Sylvain Favrot and Jörg Buchholz

CAHR, Department of Electrical Engineering, DTU, Ørsteds Plads, Bygning 352, 2800 Kgs. Lyngby, Denmark

In the present study, a novel multi-channel loudspeaker-based virtual auditory environment (VAE) is introduced. The VAE aims at providing a versatile research environment for investigating the auditory signal processing in real environments, i.e., considering multiple sound sources and room reverberation. The environment is based on the ODEON room acoustic simulation software to render the acoustical scene. ODEON outputs are processed using a combination of different order Ambisonic techniques to calculate multi-channel room impulse responses (mRIR). Auralization is then obtained by the convolution of the mRIR with an acoustic signal. The derivation of the mRIRs takes into account that (i) auditory localization is most sensitive to the location of the direct sound and (ii) that auditory localization performance is rather poor for early reflections and even worse for late reverberation. Throughout the VAE development, special care was taken in order to achieve a realistic auditory percept and to avoid "artefacts" such as unnatural coloration. The performance of the VAE has been evaluated and optimized on a 29 loudspeaker setup using both objective and subjective measurement techniques.