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Publication date: 2019

Document Version
Publisher's PDF, also known as Version of record

Link back to DTU Orbit

Citation (APA):

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Investigating Room Acoustical Effects of Simulated Clinic Rooms on Sound-Field ASSR Measurements Using a Virtual Acoustic Environment

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Objectives
There is a growing interest in using sound-field auditory steady-state response (ASSR) to objectively validate hearing-aid fitting in pre-lingual infants. In practice, sound-field ASSR will be measured in clinic rooms with non-anechoic acoustic conditions. As the ASSR magnitude is dependent on the amount of modulation in the stimulus, any reduction due to room acoustics could affect the clinical viability of the sound-field test. This study investigates the relationship between observed soundfield ASSR magnitude and changes to stimulus modulation brought about by the acoustical properties of simulated clinic rooms.

Methods
ASSR was recorded from normal-hearing adults in a virtual acoustic environment (VAE) where various clinic room sound-fields were simulated. The Phased Acoustical Radiosity and Image Source Method (PARISM), was used to simulate the various rooms. This was coupled with the nearest loudspeaker mapping (NLM) reproduction technique to control a spherical array of 65 loudspeakers within an anechoic chamber. ASSR was elicited with an ISTS-modified version of the narrow-band CE-Chirps presented at a nominal broadband level of 65 dB. This novel stimulus was created based on a two-octave-band wide chirp centred at 707 Hz, and two one-octave-band wide chirps centred at 2000 and 4000 Hz. Each band was presented at an individual rate in the 40, 90 and 90 Hz ranges, respectively. The ISTS modifications will eventually ensure that hearing aids under test will apply speech-appropriate gain and signal processing.

Results
The noise-corrected ASSR amplitude, detection rate, and detection time were analyzed across all room conditions. Additionally, the detrimental effects of room acoustics on the stimulus modulation were quantified. The results indicate that the degradation of the stimulus modulation can be reflected in the ASSR measurements.

Conclusions
A virtual acoustic environment has been proposed to investigate the effect of clinic room acoustics on sound-field ASSR. We suggest that careful consideration should be taken concerning the room where sound-field ASSR measurements will be conducted due to the degradation of the stimulus modulation produced by acoustics of the measurement rooms.

Research Highlights
1. Sound-field ASSR recorded in a virtual acoustic environment.
2. Changes on stimulus modulation due to room acoustics reflected in ASSR measurements.

Keywords Sound-field ASSR, Stimulus modulation, Clinic environments for sound-field ASSR measurements