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Towards Predicting Room Acoustical Effects on Sound-Field ASSR from Stimulus Modulation Power

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Publication date:
2018

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

Citation (APA):
Zapata Rodriguez, V., Laugesen, S., Jeong, C-H., Brunskog, J., & Harte, J. M. (2018). *Towards Predicting Room Acoustical Effects on Sound-Field ASSR from Stimulus Modulation Power*. Abstract from 41st MidWinter Meeting of the Association for Research in Otolaryngology, San Diego, United States.

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Topic

Auditory Prostheses

Abstract

One of the most important goals in early intervention of hearing loss is to ensure the child's access to speech This can enable hearing impaired infants to develop language skills to a level comparable to normal-hearing infants. Hearing-aid fitting validation is important to ensure an appropriate amplification. However, this becomes challenging in pre-lingual infants because they do not respond to behavioral tests. For this reason, there is a growing interest in using objective electrophysiological measures for hearing-aid validation. Here, an approach based on the auditory steady-state response (ASSR) is considered. Instead of using insert earphones to deliver the stimuli, as is customary, the auditory signals are reproduced from a loudspeaker placed in front of the subject, so as to include the hearing aid in the transmission path. Loudspeaker presentation of the stimulus can lower its effective modulation depth due to reverberation and background noise in the measurement room. This could be critical for the quality of the measurement as ASSR magnitude is dependent on the amount of modulation in the stimulus. Previous studies have shown a reduction in the response magnitude as the modulation depth decreases, indicating a slope of about s = 0. 8

between response magnitude and modulation depth both in dB (Boettcher et al. , 2001; Rønne, 2012; Bharadwaj et al. , 2015). However, the relation between observed sound-field ASSR magnitude and changes to stimulus modulation brought about by the acoustical properties of the measurement room has not been considered. The present work explores the relation between the stimulus modulation power and the ASSR amplitude in a simulated sound-field ASSR data set with varying reverberation time. Three rooms were simulated using the Green's function approach, and the impulse responses were convolved with narrow-band (NB) CE-Chirps centered at the octave-bands of 0. 5, 1. 0, 2. 0 and 4. 0 kHz. Fifteen normal-hearing adults were presented with the auralized stimuli, as well as an unmodified 'dry' version using insert earphones. The modulation power analysis is done based on the physiological input/output curves previously mentioned. This study discusses to what extend this modulation-growth function can be used as a prediction model to determine the changes in the ASSR amplitude based on the stimulus modulation in the room.

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