T31: IMPROVING ITD-BASED LOCALIZATION OF BILATERAL CI USERS BY SELECTED TEMPORAL MANIPULATION OF THE SOUND'S ENVELOPE

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Interaural time differences (ITDs) help normal hearing (NH) listeners perceive, locate and understand sounds in noisy and reverberant conditions. However, users of bilateral cochlear implants (BiCI) show only limited sensitivity to ITDs in the timing of electrical pulses at the high rates used in most CIs, but they can utilize ITDs in the amplitude envelope applied to the pulse train, particularly if that envelope is characterized by deep modulations and sharp onsets. In natural listening situations with background noise and reverberation, however, both characteristics are disrupted (Monaghan et al., 2013). Monaghan & Seeber (2016) therefore developed an onset enhancement (OE) algorithm that selectively sharpens and deepens modulations at onsets of selected peaks in the signal envelope. The algorithm was shown to improve envelope ITD sensitivity for NH individuals listening through a tone vocoder, and for BiCI users (Wijetillake & Seeber, 2015). It uses knowledge of the short-term direct-to-reverberant ratio (DRR) to select peaks that are dominated by the direct sound rather than reflections and applies enhancements at the times of envelope peaks. However, analysis revealed that envelope peak timings do not optimally convey the source's ITD in reverberation.

Wijetillake et al. (2017) presented an updated version of the OE algorithm that additionally estimates the short-term ITD from the signal's temporal fine structure and encodes that ITD in the timing of enhancements. Furthermore, the new algorithm enhances envelope peaks selected by the short-term interaural coherence (IC), which, unlike the DRR, requires no a-priori knowledge. Evaluations with a vocoder version revealed that the algorithm significantly improved ITD sensitivity, for all DRRs examined, relative to the old algorithm and unenhanced case, without degrading speech understanding.

For the present study, the algorithm was implemented on the RIB II research interface for testing users of Med-El CIs with a comprehensive binaural test suite in virtual acoustic reality. The new algorithm is evaluated against the old algorithm and unenhanced processing with regard to the sensitivity to the ITDs of the direct sound in (simulated) reverberation and to speech understanding. The former is assessed with an intracranial lateralization test, the latter with an Oldenburg sentence test. Both tests employ speech stimuli convolved with binaural room impulse responses (BRIR) that simulate conditions in a reverberant rectangular gypsum-walled room. The simulated source-receiver distances of the BRIRs are varied to generate different DRRs. The ITD of the direct signal is adjusted, and the interaural level difference (ILD) set to 0 dB, without altering the reflected signals. This ensures that outcomes are not confounded by ILD cues in the direct signal or by shifts in the position of reflections. Results from the ongoing evaluation will be presented.

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Literature:

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