The potential of objective T-level determination in CI recipients using envelope following responses

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Cochlear implants (CIs) restore hearing in people with severe to profound hearing loss by electrically stimulating the auditory nerve. The correct tuning of the stimulation parameters is crucial for optimal hearing performance. These parameters are repeatedly adjusted during so-called CI fitting sessions, in an interactive procedure between a clinical expert and the CI recipient. However, for a number of reasons, objective CI fitting is becoming increasingly important due to its potential for automation, reduction of clinical effort, and accommodation of the expected increase in CI users.

Objective measures, such as the electrically evoked auditory steady-state response (EASSR), are electrophysiological measures of neural responses following the stimulation of the CI. They can be recorded via electroencephalogram (EEG), and can be used to make an objective statement about the CI stimulation parameters. For example, the presence of EASSRs in EEG recordings with decreasing stimulation level can be used to objectively determine the minimal current stimulation level (T-level) used in the CI stimulation strategy.

A major challenge in using EEG recordings of EASSRs are the stimulation artifacts from the implant itself, which contaminate the recordings and make the interpretation of the presence of the EASSR prone to be false positive. However, a recently introduced method [Schott et al. (2022) - 10.23919/EUSIPCO55093.2022.9909607], based on system identification (SI), has shown promising results to overcome this problem and enable objective fitting using EASSRs, obtained with clinical stimulation settings of the CI (900pps, monopolar mode). A remaining shortcoming is the necessity of at least two EEG recordings at different modulation frequencies, to reliably separate EASSR and stimulation artifact.

In this contribution, we present an improved objective measure for CI users that allows reliable response detection within a single recording. It is adapted from the envelope following response (EFR) [Purcell et al. (2004) - 10.1121/1.1798354] and tailored to the use in CI recipients. The preliminary results show, that we can record EFRs in CI recipients and that we can separate them from the stimulation artifact, using the SI method. The response properties, i.e., response latency and amplitude, are similar to conventional EASSR response latency and amplitude. EFRs are therefore potentially better suited for objective T-level detection, as they can be detected with a single EEG recording.

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