Optimal Frequency-to-electrode Map for Electro-acoustic Listeners and the Role of Speech Modulation and Across Channel Synchrony

Ladan Zamaninezhad[1], Volker Hohmann[1], Tim Jürgens[1]

[1]Universität Oldenburg, Oldenburg

The emergence of electro-acoustic (EA) listeners, i.e., cochlear implant (CI) users with ipsilateral low frequency acoustic hearing, brings up challenges for the joint fitting of electric and acoustic stimulation. Whether to transfer the full frequency bandwidth of the input acoustic signal via CI (overlapping with the acoustically transmitted frequency range), or a restricted frequency range (a non-overlapping map), is an open question. Considering the audiogram alone may not be enough to choose the optimal map. The goal of this study is to investigate if considering the spread of electric field (SoE) in addition to the audiogram helps to choose the optimal map for EA listeners.

An auditory model of speech intelligibility with physiologically-inspired frontend for feature extraction and automatic speech recognizer backend was employed as a hypothetical EA listener. Speech reception thresholds (SRTs) were predicted as a function of SoE and as a function of the upper bound of residual acoustic hearing for both overlapping and non-overlapping maps. The results showed that for large SoE and sufficiently preserved residual acoustic hearing, the non-overlapping map outperformed the overlapping map by up to 4 dB in SRT. For other combinations the performance with both maps was comparable.

The reason for improved SRTs with the non-overlapping map was then identified either by systematically removing speech information or introducing spectral asynchrony across channels, and comparing the predicted SRTs for both maps. The non-overlapping map mitigated channel interaction due to deactivated apical electrodes. The presence and synchronicity of speech modulations in the remaining apical CI channels was found to be crucial for the benefit of the non-overlapping map.