Towards improving cochlear implant users’ speech perception by discarding non-informative channels - A model-based study

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Cochlear implants (CIs) have enabled deaf or profoundly hearing-impaired patients to acquire acceptable levels of speech intelligibility. Nevertheless, the speech intelligibility of CI users is not comparable with normal hearing listeners, especially in challenging acoustic environments. Poor spectral resolution due to channel interaction is one limiting factor for CI users’ speech perception. One idea to reduce channel interaction is to deactivate electrodes that do not transfer independent information. Identification of such channels however is not straightforward and most likely requires an individual procedure. This study aims at developing an approach to improve the speech intelligibility of CI users by identifying and deactivating the non-informative channels for individuals.

An auditory model of speech intelligibility for CI users was employed to simulate individual spread of electric fields. The model receives speech waveforms as input and produces internal representations (IRs, the post-processed auditory nerve spiking pattern). Based on individual IRs, Amplitude Modulation correlation matrices (AMcorr) were produced and used to individually select a subset of channels with independent information. The model back-end classifies the IRs and returns the predicted speech reception thresholds (SRTs).

The results showed individual patterns of AMcorr matrices, confirming the hypothesis that selection of non-informative channels is an individual procedure. The predicted SRTs of one hypothetical patient as a function of active electrodes, when ranked according to their importance, showed a minimum for the case when only a subset of electrodes was active. This shows that the proposed procedure may identify non-informative channels and improve transmission of relevant speech information on an individual level. This needs to be investigated further by gathering subjective data in a group of patients.