TOWARDS IMPROVING SELECTIVE HEARING IN COCHLEAR IMPLANT LISTENERS

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Selective Hearing and Cochlear Implants

Cochlear implants (CIs)
• most successful neuroprosthesis worldwide, surgically implanted
• used in cases of severe-to-profound hearing loss or deafness
• directly stimulate the auditory nerve (AN) with an array of electrodes

Motivation for DOC Project

• CIs have to bridge a gap between electrode array and AN
• In this gap, the electric current spreads and stimulates more neurons than intended for a certain electrode (figure on the right), creating so-called channel interactions
• The stimulation approach determines which information is transmitted with CIs (figure on the left): HR transmits mainly speech information, LR mainly directional (interaural time differences, ITD) and pitch information; HR vs. LR trade-off
• In our lab, HR-like SIPI signals were shown to provide LR-like ITD & pitch sensitivity on single electrodes [5,8]

Approach

• Selective hearing (here: speech plus ITD plus pitch) requires many electrodes to stimulate
• SIPI has to be tested in multi-electrode settings (figure on the left) to assess its potential to improve selective hearing
• First step: Dual-electrode stimulation
• Between-electrode delay is varied
• Effect of channel interactions on ITD and pitch perception?
• Electrode selection based on fmSTCs and interaural electrode matching (figure on the right)
• Next steps: more electrodes, more complex hearing tasks

Current spread and channel interactions
Pulse trains from multiple electrodes sum up in the gap between electrode and neuron. Pulses are interleaved to reduce interactions.

Internal electrode matching [cf. 1, 4]
Between ears, insertion depths of electrode arrays vary. ITD-based interaural electrode pairing maximizes binaural sensitivity.

Forward-masked spatial tuning curve [fmSTC, cf. 6]
fmSTCs are used as an approximator of channel interactions. Both apically (A) and basally (B), dual-electrode stimuli with max. interactions (narrow, N, see figure above) and min. interactions (wide, W) are constructed.