DTU Electrical Engineering

STUDENT PROJECT PROPOSAL:
"Modeling speech intelligibility in cochlear implant recipients"

Project type: ☒ **M.Sc. thesis** ☐ **B.Sc. thesis** ☒ **Special course**

Duration: **18 or 21 weeks** ECTS: **30 or 35**

Starting date from: **Flexible**

Project description:

Cochlear implants (CIs) aid profoundly deafened individuals by directly stimulating the auditory nerve. In most commercial CI processors, sound is first filtered into frequency bands with a bank of bandpass filters. Then variations in the envelopes within each band are encoded via the delivery of electrical current through a set of electrodes that sit in an array along the cochlear. When the incoming sound specifically contains speech, the presented stimulation pattern is assumed then to encode the underlying structure of the speech that is essential for making the speech intelligible. However, when the incoming sound is speech mixed together with noise, CI processors often fail to encode the underlying information well enough for the CI recipients to be able to understand the speech.

One common approach for investigating how or why the stimulation pattern for the noisy speech fails to encode the underlying speech information well enough is to compare the stimulation pattern for the noisy speech with the stimulation for the same speech presented in quiet—which is assumed to encode the information more accurately. From a signal detection standpoint, the stimulation pattern for the noisy speech then contains two different types of stimulation errors: stimulation on an electrode that should not have been stimulated (i.e., a false positive error) or the lack of stimulation on an electrode that should have been stimulated (i.e., a false negative error). It is not too difficult to imagine that the more stimulation errors there are, the more likely it is that the recipient will be unable to understand the encoded speech. However, Kressner *et al.* (2016) have also shown that stimulation errors can be more detrimental to speech intelligibility if they themselves are *structured* as opposed to random (i.e., distributed in a way that a stimulation error at one point in time on an electrode co-occurs with an error in a neighboring point in time or on a neighboring electrode with above chance-level probability). However, it is unclear by exactly how much a specific stimulation error at one electrode in time alters the effect of a second error, for example, two electrodes away three stimulation cycles later. Thus, the main objective of this project is to quantify the spectro-temporal dependency of the effect of cochlear implant stimulation errors on speech intelligibility. To accomplish this, the project will involve extracting insights from a large dataset of stimulation patterns which have been presented to cochlear implant recipients in previous speech intelligibility listener studies.

References:

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Kressner, A. A., Westermann, A., Buchholz, J. M., & Rozell, C. J. (2016). Cochlear implant speech intelligibility outcomes with structured and unstructured binary mask errors. The Journal of the Acoustical Society of America, 139(2), 800-810.

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