Master Thesis Proposal 2021/2022

Title: A multi-dimensional space-time-frequency representations in speech perception

Supervisors: Emina Alickovic & Martin Skoglund (Adj. Assoc. Professors at LiU & Senior Researchers at Oticon A/S),

Background: Natural listening situations that require listeners to selectively attend to a talker of interest in noisy environments with multiple competing talkers are among the most challenging situations encountered by hearing impaired listeners. Such challenges become even more pronounced with increasing background noise and may partially be overcome by adequate hearing aid signal processing support. A key finding that helped the field to progress is that speech-evoked brain responses recorded with electroencephalogram (EEG) are modulated by listener's auditory attention, revealing selective brain tracking (BT) of the target talker**.** Hearing aid strategies were also found to support auditory attention in the hearing-impaired brain. However, BT methods proposed in the literature are entirely based on time, which has yielded a series of relevant findings. However, initially good space-time-frequency resolution is lost.

Project description: We now want to work at new space-time-frequency characterization of human multichannel EEG in order to develop new methods that can help us understand how speech is understood in noise. Great challenges with EEG and audio are high dimensionality and low SNR. This knowledge will bring us one step closer to having intelligent hearing devices that can track the listener's brain and automatically adjust its settings to improve speech understanding in noise.

Method: The datasets will be provided by Eriksholm Research Centre (a part of the world-leading hearing aid manufacturer Oticon A/S). The dataset contains EEG data collected from 22 participants fitted with hearing aids. The participants were instructed to attend to one of two simultaneous talkers in the foreground mixed with multi-talker babble noise in the background.

Program Duration: 20 weeks, 30HP, with a flexible starting date.

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Relevant Literature:

[1] Alickovic, Emina, et al. "Neural representation enhanced for speech and reduced for background noise with a hearing aid noise reduction scheme during a selective attention task." Frontiers in neuroscience 14 (2020): 846.

[2] Alickovic, Emina, et al. "Effects of hearing aid noise reduction on early and late cortical representations of competing talkers in noise." Frontiers in Neuroscience 15 (2021).

[3] Viswanathan, Vibha, Barbara G. Shinn-Cunningham, and Michael G. Heinz. "Speech categorization reveals the role of early-stage temporal-coherence processing in auditory scene analysis." bioRxiv (2021).