Master Thesis Proposal 2021

Title: A System Identification Approach to Brain-Based Monitoring of Sound

Supervisor: Emina Alickovic (LiU/Oticon)

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 amplification and noise reduction support. A key finding that helped the field to progress is that speech-evoked brain responses recorded with EEG are modulated by listener's auditory attention, revealing selective tracking of the target talker**.** A noise reduction scheme in commercial hearing aids was also found to support auditory attention in hearing impaired brain. However, what is not known is was how different adaptive amplification and noise reduction strategies affect auditory attention in distinct hierarchical stages of the brain.

Project description: We now want to answer this question by using black-box models borrowed from system identification (e.x. causal FIR filter). This knowledge will give a deeper understanding of the effects of hearing impairment on the person's ability to follow the speech in complex listening situation, which is needed in order to further advance hearing aids.

Method: The datasets will be provided by Eriksholm Research Centre (part of the world-leading HA manufacturer Oticon A/S). The dataset contains EEG data collected from 35 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.

Prerequisites: (1) Mathematical Statistics, (2) Digital Signal Processing, (3) Modeling and Learning for Dynamical Systems

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

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Relevant Literature:

[1] E. Alickovic, T. Lunner, F. Gustafsson and L. Ljung, "A tutorial on auditory attention identification methods", Frontiers in neuroscience, 13, 153, 2019.

[2] Lunner, T., Alickovic, E., Graversen, C., Ng, E. H. N., Wendt, D., & Keidser, G. (2020). Three new outcome measures that tap into cognitive processes required for real-life communication. Ear and hearing, 41(Suppl 1), 39S.

[3] Alickovic, E., Lunner, T., Wendt, D., Fiedler, L., Hietkamp, R., Ng, E. H. N., & Graversen, C. (2020). 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, 846.

[4] E. Alickovic, et al. "Effects of hearing aid noise reduction on early and late cortical representations of competing talkers in noise", 2020, submitted to Frontiers in neuroscience (in review).