BSc/MSc-project

Title: **"Model-in-the-loop" fitting of hearing-aid amplification**

Description:

Cochlear hearing loss is a result of damage to sensitive structures of the inner ear and the subsequent impairment of the active biological mechanisms involved in the normal processing of the acoustic input. Apart from a loss of sensitivity to low-intensity sounds, this results in a distorted internal representation of the stimuli at the level of the auditory nerve.

The goal of hearing-aid amplification is to map the acoustic input into the limited dynamic range of hearing-impaired (HI) listeners while introducing as little additional distortion as possible. However, these two requirements often counteract each other. For example, fast-acting compression provides superior speech audibility, but at the same time introduces distortion that affect the natural separation of sources or spatial perception.

The procedures currently used for the prescription of hearing-aid amplification do not take the aforementioned trade-off into account. In an initial study, Sabin and Souza (2013) proposed a procedure for optimizing hearing-aid gain using a genetic algorithm. The optimal prescription had to satisfy several criteria such as audibility, loudness and minimal distortion of the temporal envelope of the acoustic input. The prescription rule based on the genetic algorithm provided, for example more low-frequency gain and a higher overall sensation level compared to the widely used NAL-NL2 procedure (Keidser et al., 2011).

The procedure used by Sabin and Souza was very simple and did not take into account many aspects of hearing loss, such as the impaired spectral and temporal resolution. The focus of this project is to utilize their approach with consideration to the signal processing that occurs in the normal and impaired auditory systems. To achieve that, the computational signal processing and perception (CASP) model of Jepsen et al. (2008, 2011) will be used. The model front-end includes a non-linear cochlear filterbank, whose parameters can be adjusted to account for various aspects of hearing loss. The outcome measure of the optimization procedure will be the correlation between the aided-impaired and the normal internal representations. The model can be further fine-tuned to account for individual hearing-loss and take into account various acoustic scenarios, resulting in a custom “model-in-the-loop” approach to fitting the hearing aid.

Literature:

Jepsen M. L., Ewert S., Dau. T (2008) "A computational model of human auditory signal processing and perception” *Journal of the Acoustical Society of America* **124** (1) pp. 422-438

Jepsen M. L., Dau T. (2011) "Characterizing auditory processing and perception in individual listeners with sensorineural hearing loss” *Journal of the Acoustical Society of America* **129** (1) pp. 261-281

Keidser G., Dillon H., Flax M., Ching T., Brewer S. (2011) “The NAL-NL2 prescription procedure” *Audiology Research* **1** (1) pp. 1-3

Sabin A., Souza P. E. (2013) "Initial development of a temporal-envelope-preserving nonlinear hearing aid prescription using a genetic algorithm” *Trends in Amplification* **17** (2) pp. 94-107

Required qualifications: Good command of MATLAB and knowledge signal processing, 31236 is a good prerequisite

Responsible institution: DTU Hearing Systems

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Allowed no of students per report: 1

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