AP 380 Individualized Adaptation of Hearing Devices

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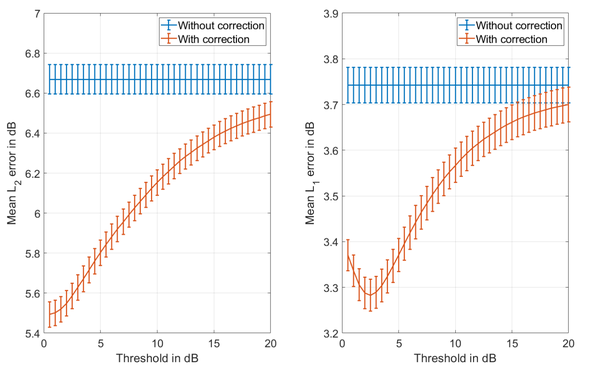
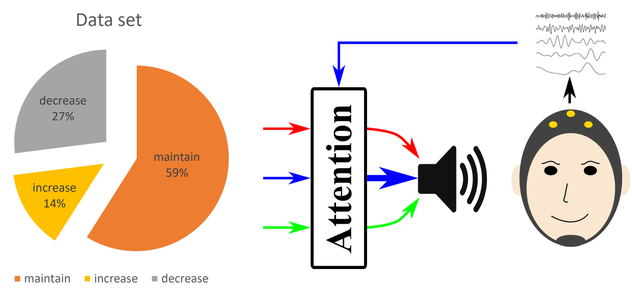
Introduction

- According to a projection of the world health organization, 25% of the worldwide population will have a hearing problem by 2050
- Hearing aids and cochlear implants are successful treatments for a wide range of hearing losses up to profound deafness
- Users show a decrease in sound reception performance in adverse listening conditions
- Unclear if the device settings are optimal for the respective user group
- The aim of this project is to use AI based techniques to optimize on an individual user level the sound reception in adverse listening condition
- The goal is to maximize the benefit that users get from their devices

Task1 : Optimized Fitting of Hearing Devices [UzL]





Regression

⇒ Dataset is unbalanced

⇒ Random forest with whitening of the fitting and feature parameters

⇒Optimal thresholds were determined, with absolute regression values below these being set to zero.

⇒ Measuring the mean error against ground-truth fitting in L_1- and L_2-norm with 40-fold cross-validation

⇒ 1-1.5 dB improvement on average in the L_2-norm and up to 0.5 dB improvement on average in L_1-norm

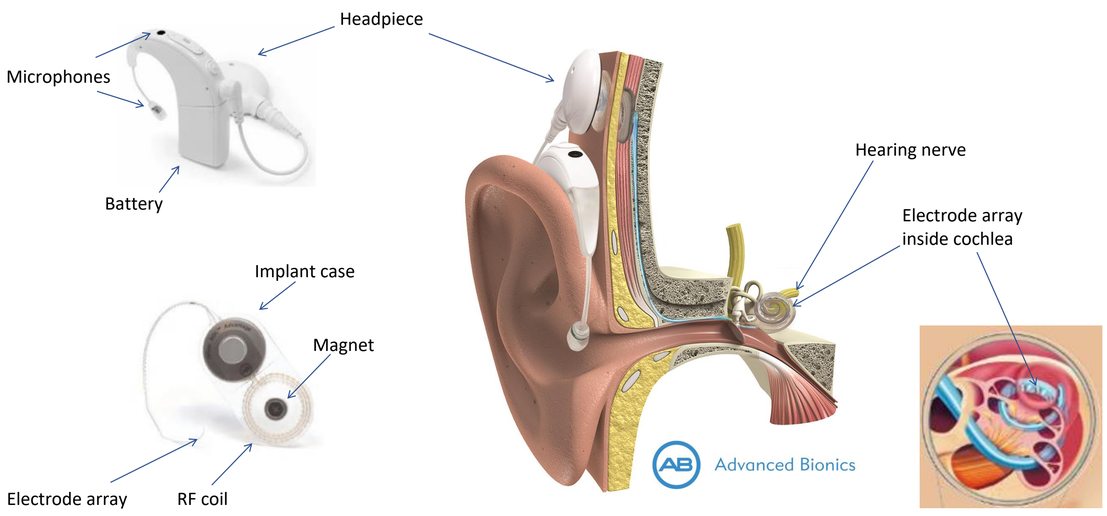
Improve fitting

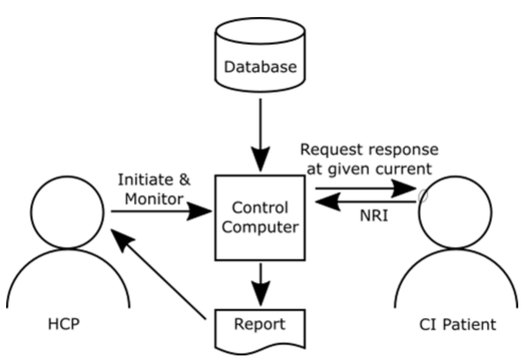
⇒ Additional information from EEG signals

Attention Decoding

⇒ First results with DNN approach

Task 3 : Fast Automated AI-based CI Fitting [AB]





AI-based Individualized CI Fitting

⇒ Fast, (semi or fully) automated determination of fitting parameters based on global and individual data as well as objective measurements performed by HCP

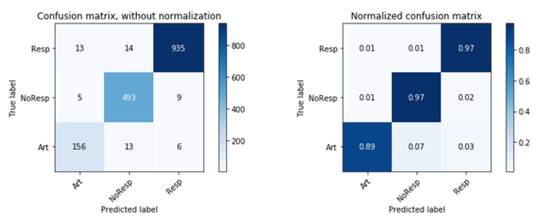
⇒ Reduced time and patient discomfort by lowering the number of NRI measurements that need to be made

DNN-based NRI Analysis

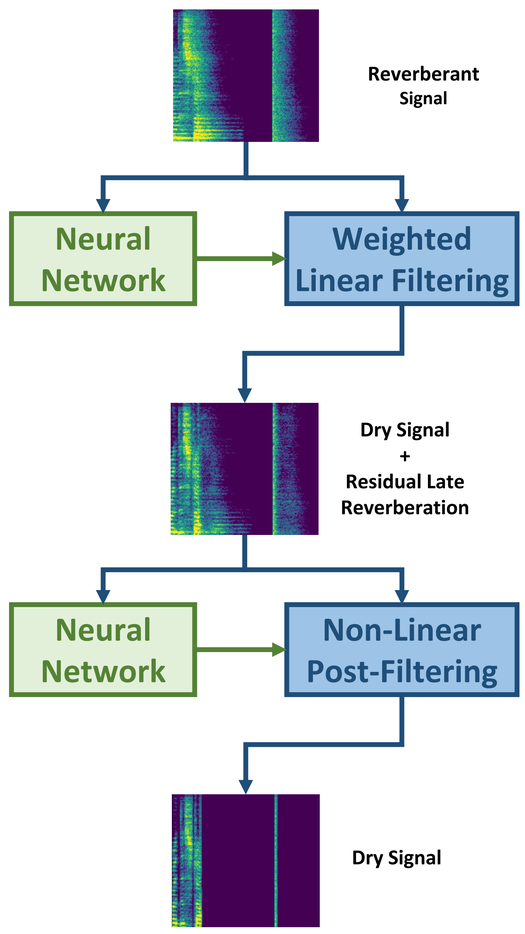
⇒ A DNN has been developed to analyse NRI responses for threshold determination

Using Big Data

⇒ Global and individual data will be used to speed up measurement and increase fitting accuracy



Task 2 : Dereverberation for Hearing Devices [UHH]



Model-based neural network approach

⇒ Combine **distortionless guarantees** of linear filtering **with powerful expressive** modelling of neural networks

⇒ Integrate traditional signal processing computations into training procedure of network through **end-to-end optimization**

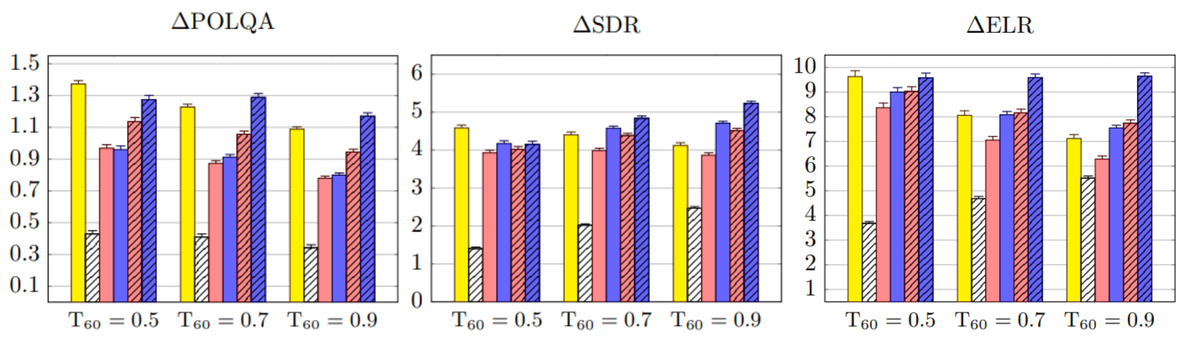
Decompose dereverberation task

⇒ **Linear filtering**: **remove moderate reverberation** while protecting direct path and early reflections

⇒ **Non-linear post-filtering: remove residual late reverberation**

⇒ **Real-time capable**

⇒ Reverberation reduction **tailored** to hearing-aid or cochlear-implanted listeners



1. J-M. Lemercier, J. Thiemann, R. Koning, T. Gerkmann, *Customizable end-to-end optimization of online neural-network supported dereverberation for hearing devices*, ICASSP 2022, June, Singapore

2. ____ , *Neural-network supported Kalman filtering for robust online speech dereverberation in noisy environments*, Interspeech 2022, September, Incheon

3. ____, *A lightweight neural-network supported algorithm with end-to-end optimized linear filtering for online dereverberation in hearing devices*, under review in IEEE TASL

Conclusions

- Progress compared to the state-of-the-art by use of AI based techniques in the fitting and signal processing for hearing aids and cochlear implants was shown in bench tests
- Fitting of hearing devices can be improved by AI-supported fitting recommendations (Task 1)
- AI based algorithms can be used for dereverberation to achieve higher suppression compared to statistical approces (Task 2)
- Classification of neurophysiological responses for cochlear implant fittings can be vastly improved by AI
- Studies need to be conducted with the respective target groups to show the real-life benefit that users can expect from the research done
- Overall goal is to evaluate all parts together in a bimodal user population which use a cochlear implant and a contralateral hearing aid

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