SENSORY NEURO ENGINEERING

Master Thesis:

Transfer Learning for Selective-Attention Decoding in Cochlea-Implant (CI) Users

Background:

While modern CIs enable patients to achieve satisfactory speech understanding in quiet environments CI users encounter significant challenges in adverse listening conditions characterized by background noise and intervening speech streams, the so-called cocktail-party effect. In such noisy environments, CI users experience notably poorer speech understanding compared to individuals with normal hearing. Recent research showed that auditory selective attention to speech in a cocktail-party situation can be decoded from non-invasive EEG recordings using machine-learning methods. This finding suggests the development of neuro-steered CIs, which could take advantage of the decoded target speech stream to amplify this particular sound source and suppress other sound streams and therefore assist CI user in communicating successfully in cocktail-party environments.
A wide range of auditory attention decoding (AAD) methods has been proposed and evaluated for normal-hearing individuals, where the development of neuro-steered hearing aids or CIs is commonly stated as a main motivation. However, the development AAD methods specific for hearing impaired individuals is lagging behind. The lack of (large) public datasets for this task is one reason among others for slower technological advancements. We gathered a novel AAD dataset for CI patients. However, it is small compared to publicly available datasets measured on normal-hearing individuals. This project aims to leverage larger publicly available datasets on normal-hearing individuals to improve AAD in CI-users by means of transfer learning.

Tasks:

- Investigate state-of-the art in AAD and transfer learning
- Propose a suitable transfer learning concept
- Implement the proposed transfer learning concept in PyTorch
- (Optionally different model architectures and AAD concepts can be investigated too)
- Run experiments (on local workstation or preferably on the HPC-cluster)
- Evaluate the concept and report the results in high-quality figures (ideally using a standard python plotting library)
- Write the thesis in Latex

Prerequisites:

- Motivation to read into a new field.
- Background in Machine-Learning (Courses, Projects...)
- Experience in python programming
- Experience in some of the following is also useful but not obligatory: PyTorch, Time-Series Analysis, HPC, Latex, transfer learning

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