Plan for the optimization of an automated EOG correction technique

# Context

One of the methods used at the Centre for Human Drug Research (CHDR) to assess the effects of drugs on the central nervous system (CNS) is the quantification of resting state electro-encephalography (EEG). For the duration of a few minutes, the cortical activity is measured in subjects during periods with eyes closed and periods with eyes opened. These recordings are transformed to the frequency domain, and split into frequency bands. The total power per frequency band is then calculated and can be used as a measure to describe the current state of the CNS.

One of the issues while recording EEG is that the amplitude of EEG signals is relatively low in comparison to artefacts. Common artefacts in EEG recordings are caused by the propagation of ocular (EOG) and muscular activity through the skull. Without correction of these artefacts, the calculated power is contaminated by them. For example, ocular activity in EEG recordings results in an overestimation of the low-frequency components, while muscular activity is generally found in the high-frequency components.

Currently at CHDR, the Grubbs’ test for outliers is used to detect artefacts in EEG recordings, and the contaminated parts are rejected for further analyses. As a result, there may be a loss of relevant information since the final endpoints are then based on fewer data-samples. An alternative strategy could be not removing the contaminated recording, but use Machine Learning (ML) techniques for correcting it such that only the artefact is removed.

# Project objective

Here, we propose a project in which an automated EOG correction technique is implemented and validated for the use in resting state EEG recordings. A literature review of existing techniques was provided by Lisa Tostrams, an Artificial Intelligence / Computer Science student. Lisa also implemented an EEG correction algorithm and demonstrated a proof-of-concept using both simulated and ‘real’ EEG data. The next step will be to document, clean, and optimize the proof-of-concept model. These tasks can be done by Lisa and will consist of

1. Cleaning and documenting of the implemented technique
2. Optimizing the calculations required for the technique
3. Optimizing and validating of technique parameters
4. Combining and documenting the results of points 1 – 3

# Description tasks

## Cleaning and documenting of the implemented technique

**Description:**The implementation of the proof-of-concept model will be cleaned and documented.   
**Expected duration:**16 hours

## Optimization of the scripts

**Description:**The goal is to have an implementation of the model that requires as few computational resources as possible. Therefore, fast algorithms to perform model’s calculations will be researched and implemented.  
**Expected duration:**32 hours

## Optimization of algorithm parameters

**Description:**The goal is to optimize the parameters required by the model such that there is a good trade-off between output-quality and calculation speed. Cross-validation on the (simulated) training dataset will be used together with parameter grid searches.  
**Expected duration:**  
48 hours

## Summarization of findings

**Description:**The findings of the above mentioned tasks will be compiled into one document.  
**Expected duration:**32 hours