Software Development: Artifact Correction in Human Neuroimaging Data

The simultaneous acquisition of electrical signals from scalp electrodes and blood-oxygenation recordings from the human brain in the magnetic resonance (MR) scanner (i.e., simultaneous EEG-fMRI) offers a novel and remarkable insight into human brain function. However, the utility of this method relies exclusively on the ability to remove strong MR-induced artifacts from the EEG data that mask the recorded electrical signals from underlying neural populations.

For the removal of these artifacts, one must record various labels in the data, relating to 1) the onset of each MR image, and 2) the heart rate. With these labels, one can accurately estimate and remove the artifacts. However, frequently, due to technical difficulties or otherwise, these labels may not be available, rendering the dataset unusable.

We have created an artifact correction method that can be used when these labels are not available. The skeleton of the algorithm, programmed in MATLAB, is ready for 1) optimisation and debugging, and 2) validation. We are looking for two students to work on these projects:

Project 1: Optimisation and Debugging (start time ASAP)
Task: create a user-friendly software package of the artifact correction method that can be used as a standalone analysis tool or be incorporated into other frequently used EEG analysis toolboxes.

Project 2: Validation (start time ASAP)
Task: Using a pre-acquired EEG-fMRI dataset, test the usability of the software and validate the accuracy of the results in comparison to the canonical methods.

These projects would allow students to gain hands-on experience in software development in the human neuroimaging research sector using the most novel methods to date. Students would also have the option of gaining hands-on experience in the acquisition of brain imaging data in humans.

Interested students should be proficient in MATLAB and a basic understanding of EEG and fMRI methodology would be useful, but not necessary. If you would be interested in either of the projects, please don’t hesitate to contact Rachel (rachel.nuttall@tum.de) to discuss the projects further.