Multimodal integration of simultaneous acquired EEG and fMRI data to study cognitive processes

Gregor Strobbe

Supervisor(s): Prof. S. Vandenberghe, Prof. Y. Rosseel

I. Introduction

Several imaging modalities exist to study human brain function non-invasively, i.e. to localize and determine the temporal dynamics of neural activity without involving entry into the body. Based on the electrical origin of neural activity, electroencephalography (EEG) allows studying brain activity on a time scale similar to specific neural events (ms) by measuring electrical potentials on the scalp. Inverse techniques try to localize the underlying neural sources out of these potentials but are mostly unreliable by lack of a golden standard.

Neural activity is accompanied with increased oxygen consumption. A coupled hemodynamic response supplies the active regions with oxygen rich blood. Functional magnetic resonance imaging (fMRI) identifies the regions of local increased oxygen supply and is based on the different magnetic properties of oxyhemoglobin and deoxyhemoglobin, whose concentrations reflect the blood oxygenation level. FMRI analysis obtains good spatial resolution of neural activity (mm) but the temporal resolution is limited (2-5s) (see Fig. 1).

II. Goals and Perspectives

In this research, the goal is to integrate fMRI and EEG data from simultaneous fMRI/EEG recordings to localize neural activity with millimeter spatial resolution and millisecond temporal resolution. Based on a spatiotemporal decomposition of both EEG and fMRI data, a model will be developed that is able to generate simultaneous EEG/fMRI recordings in terms of the same parameters that represent the underlying electrophysiological activity. By fitting this model to the actually acquired EEG/fMRI data we can estimate the parameters that best characterize the unknown underlying activity. An innovating aspect of this research is the creation of a head phantom to validate our methods, meaning that the EEG and fMRI signal generators will be imitated to obtain a golden standard. In collaboration with UZ ghent we have access to a 3 Tesla magnetic resonance scanner. Prof. Y. Rosseel will support the fMRI analysis in the context of the MRP Neuroscience research project.

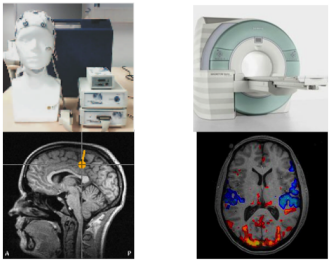

Figure 1. EEG (left) and fMRI (right) imaging

III. Conclusion

A technique to estimate neural sources from simultaneously measured EEG/fMRI signals would greatly benefit the investigation of neural activation in the brain during cognitive processes.

References

[1] Christoph Mulert, Louis Lemieux *EEG-fMRI, Physiological Basis, Technique and Applications*