Time Series Analysis for Near-Infrared Spectroscopy Data

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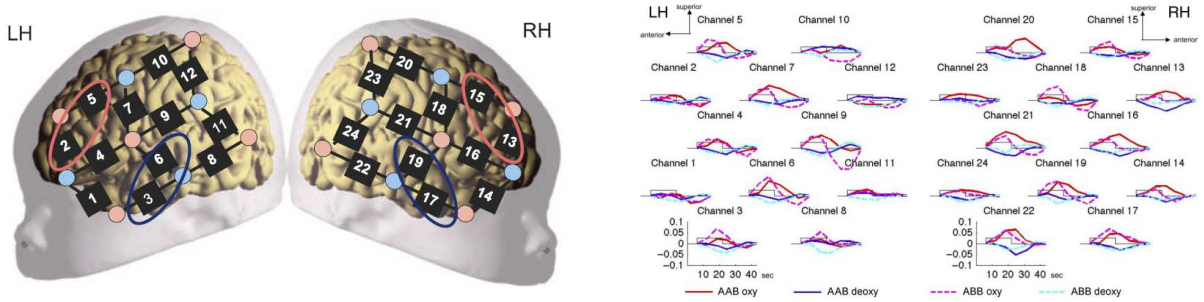
Near-InfraRed Spectroscopy (NIRS) is a relatively recent, but rapidly expanding neuroimaging technique, using near-infrared light to measure the concentration changes in oxygenated and deoxygenated hemoglobin related to focal brain activity [1]. The technique is non-invasive, easy to use, portable and relatively inexpensive. It requires no tracer substance or magnetic field, it is relatively tolerant to motion artifacts and it is completely silent. Given these advantages, it is often used with populations and tasks where the functional Magnetic Resonance Imaging (fMRI) technique is not suitable, e.g. with preterm babies, neonates and young infants or actively behaving participants (e.g. children and adults performing a behavioral task). While NIRS is increasingly popular, it is still a relatively new technique, and sophisticated data analysis techniques are still lacking. Our understanding of the hemodynamic response, which NIRS measures, is also incomplete, especially in developmental populations, rendering analysis methods that rely on heavy assumptions about the underlying physiology impractical. Compromised data quality due to hair and strong movement artifacts, typical in babies, also plague data analysis.



This project involves the analysis of previously published as well as unpublished NIRS data (from experiments with newborns on speech perception [2]), which can be represented as time series, using time series management and analysis techniques [3,4,5]. The advantage of these techniques is that they can efficiently operate on the original, fully detailed data, taking into account the trends that these data exhibit. Therefore, we can use similarity search to identify NIRS data that follow similar trends over time and subsequently group those together in clusters, or detect abnormal behaviors.

The aim of this project is to provide a new, more robust and assumption-free method for NIRS analysis. This new method will allow us to exploit the data in more detail, uncover hitherto unseen patterns and trends that do no reach significance in traditional statistical tests and to provide a better description of the hemodynamic response in young infants.

Accepting this project will make you part of an enthusiastic team working on real, challenging problems!
Prerequisites: computer science background, and a very good knowledge of a programming language.

References

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