

Decoding fMRI functional connectivity: pattern recognition on a restricted class of graphs

Jonas Richiardi, Dimitri Van De Ville

With the realisation of the limitations of mass-univariate statistical methods for fMRI data analysis, the last ten years have brought remarkable advances in the sophistication of methods. Many techniques and algorithms have been borrowed from machine learning and pattern recognition, under the term 'brain decoding' or 'brain reading'. The vast majority of techniques use some normalisation of the BOLD signal levels as features, an approach we term "activation-based decoding". Another view of the data can be gained by looking at functional connectivity, which considers temporal correlations between brain regions of the brain at rest or during tasks.

This talk will focus on an emerging technique we recently proposed, connectivity-based decoding. This is an interesting tool for neuroimagers and provides complementary information to both activation-based decoding and qualitative analysis in terms of graph-theoretic properties. It is applicable to both brain state decoding and clinical applications such as diagnosis. After a whole-brain regional functional connectivity graph has been established, the problem can be cast as a weighted graph classification task. We will show that the graphs of interest form a restricted class of graphs whose properties prevent the application of classical graph matching techniques to elicit a useful distance or dissimilarity between graphs, and advocate for the use of modern graph embedding methods. We will present several vector space representations of graphs that are suitable for the class of graphs of interest, and discuss experimental results.