A Bayesian Approach for Estimating Dynamic Functional Network Connectivity in fMRI Data

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ABSTRACT

Dynamic functional connectivity, that is, the study of how interactions among brain regions change dynamically over the course of an fMRI experiment, has recently received wide interest in the neuroimaging literature. Current approaches for studying dynamic connectivity often rely on ad hoc approaches for inference, with the fMRI time courses segmented by a sequence of sliding windows. We propose a principled Bayesian approach to dynamic functional connectivity, which is based on the estimation of time varying networks. Our method utilizes a hidden Markov model for classification of latent cognitive states, achieving estimation of the networks in an integrated framework that borrows strength over the entire time course of the experiment. Furthermore, we assume that the graph structures, which define the connectivity states at each time point, are related within a super-graph, to encourage the selection of the same edges among related graphs. We apply our method to simulated task -based fMRI data, where we show how our approach allows the decoupling of the task-related activations and the functional connectivity states. We also analyze data froman fMRI sensorimotor task experiment on an individual healthy subject and obtain results that support the role of particular anatomical regions in modulating interaction between executive control and attention networks.