Bayesian modeling in neuroimaging: Brain networks' dynamics

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Room BENVENUTI

Department of Statistical Sciences

Brain imaging data, particularly functional magnetic resonance imaging (fMRI), exhibit complex spatial and temporal correlations. We will begin by highlighting the critical role of statistical approaches in analyzing such data. More specifically, we will discuss approaches to studying dynamic brain connectivity, which seeks to understand the changing interactions between different brain regions over time. We will present two recent Bayesian approaches to capture these dynamic relationships within multivariate time series data. First, we will present a scalable Bayesian time-varying tensor vector autoregressive (TV-VAR) model that efficiently captures evolving connectivity patterns. This model leverages a tensor decomposition of the VAR coefficient matrices at different lags and sparsity-inducing priors to capture dynamic connectivity patterns. Next, we introduce a Bayesian framework for sparse Gaussian graphical modeling that employs discrete autoregressive switching processes. This method improves dynamic connectivity estimation by modeling state-specific precision matrices and using novel prior structures to account for temporal and spatial dependencies. Throughout the talk, we will illustrate the performance of these Bayesian methods with examples from simulation studies and real-world fMRI data.

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