

Seminar: May 2, 2022

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Title: Bayesian Time-Varying Tensor Vector Autoregressive Models for Dynamic Effective Connectivity

Abstract: An improved understanding of the heterogeneity of brain mechanisms is considered critical for developing interventions based on observed neuroimaging features. Recently, neuroscientists have been particularly interested in understanding how the brain reorganizes functional networks between brain areas throughout a neuroscience experiment. In this talk, we will look at functional magnetic resonance imaging (fMRI) data and discuss a computationally efficient time-varying Bayesian vector autoregressive (VAR) approach for studying dynamic effective connectivity. Effective connectivity is defined as the direct influence that one brain region exerts on another. The proposed framework employs a tensor decomposition for the VAR coefficient matrices at different lags. Dynamically varying connectivity patterns are captured by assuming that only a subset of components in the tensor decomposition is active at any given time. Latent binary time series select the active components at each time via a convenient Ising prior specification. The proposed prior structure encourages sparsity in the tensor structure and allows ascertaining model complexity through the posterior distribution. More specifically, sparsity-inducing priors are employed to allow for global-local shrinkage of the coefficients, automatically determine the rank of the tensor decomposition, and guide the selection of the lags of the auto-regression. We will show the performances of our model formulation via simulation studies and data from an actual fMRI study involving a book reading experiment.