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# Spectral partitions of brain graphs and stochastic block models

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The human brain is estimated to have 80 billion neurons and several hundred trillion connections. Large graph models are used in connectomics, the study of how neurons are connected. Currently, anatomical features of the brain are used for medical diagnosis; however, understanding connections with the brain could lead to higher accuracy in diagnosis. Psychiatric disorders, in particular, are believed to be "connectopathies," so recognizing changes in connections within a patient over time or between two patients may be crucial to understanding and diagnosing psychiatric diseases.

Imaging techniques such as MPRAGE, FLAIR, DTI, diffusion MRI, resting state fMRI, etc. allow us to estimate graphs characterizing connections in the human brain. These approaches divide the brain into approximately 10 million voxels (native resolution of these imaging modalities), 1 million of which are in the largest connected component. The resulting graphs consist of approximately 50 million weighted edges (connections).

In this talk we explore two spectral partitioning methods, adjacency spectral embedding (ASE) and the random walk normalized Laplacian (RWNL) for analyzing graphs and apply them to the brain graphs. These two methods give rise to two anatomical partitions of the graphs. ASE partitions into gray and white matter while the RWNL yields partitions that divide the brain into hemispheres. Stochastic block models of the brain regions are used to model the graphs and expose geometry of ASE and RWNL as they relate to the brain graphs.

*This is joint work with Carey Priebe, Joshua Vogelstein, and Vince Lyzinski of Johns Hopkins University.*

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