Bayesian Modeling for Brain Connectivity and Its Link to Genetics and Behavior

Dr. Yize Zhao
Yale University

Abstract:
Brain functional and structural connectivity, the unique measures for brain network organizations, have become emerging endophenotypes to dissect molecular contributions, as well as provide a great potential to explain the neurobiological underpinning of behavioral profiles. In this talk, I will first discuss a study on the complex impact of multi-state functional connectivity on behaviors by analyzing the data from a landmark brain development and child health study. In this work, we propose a nonparametric Bayesian supervised heterogeneity analysis to uncover neurodevelopmental subtypes with distinct effect mechanisms. Through integrating resting-state and task-related functional connectomes, we dissect heterogeneous effect mechanisms on children's fluid intelligence from the functional network phenotypes under different cognitive states. Then, I will discuss a biologically plausible brain network response shrinkage model to comprehensively characterize the relationship between high dimensional genetic variants and brain structural connectivity among healthy young adults from Human Connectome Project. Within the Bayesian paradigms, we accommodate the topology of brain network and biological architecture within the genome. Finally, we further incorporate the disease outcome, and I will demonstrate a mediation analysis to explore the causal effect mechanism among genetic exposure, structural connectivity and time to disease onset with application to Alzheimer's disease.