NJIT New Jersey Institute of Technology

BME

Department of Biomedical Engineering

Graduate Seminar

Dr. Zening Fu

Research Assistant Professor

Trends Center

GSU-Emory-Georgia Tech

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11:30am - 1:00pm

CKB 303

Never Rest: Transient Brain Dynamics, Cognition and Psychiatric Problems in Children

Abstract:

Children's brains dynamically adapt to the stimuli from the internal state and the external environment, allowing for changes in the cognitive and mental behavior of individuals. In this work, we performed a large-scale analysis of dynamic functional connectivity (DFC) in children aged 9~11 years, investigating how brain dynamics relate to cognitive performance and mental health at an early age. An adaptive independent component analysis framework was applied to the Adolescent Brain Cognitive Development (ABCD) data containing 10,988 children. We combined a sliding-window approach with k-means clustering to identify five reoccurring brain states with distinct DFC patterns. Interestingly, the occurrence of a strongly connected state was negatively correlated with cognitive performance and positively correlated with dimensional psychopathology in children. Meanwhile, the opposite relationships were observed for a sparsely connected state. The composite scores, the attention score, and the Attention-Deficit/Hyperactivity Disorder score were the most significantly correlated with the DFC states. The cognitive and psychiatric relevance of DFC states were highly reproducible across scans and between longitudinal sessions. Finally, the mediation analysis showed that attention problems mediated the effect of DFC states on cognitive performance. This investigation unveils the neurological underpinnings of DFC by highlighting their robust associations with behavioral performance in childhood. Tracking the patterns of DFC states may capture cognitive and mental problems in children and guide people to provide early intervention to buffer adverse influences.

About the Speaker

Dr. Zening Fu is a Research Assistant Professor at Trends Center a tri-instutional Consortium between GSU, Emory and Georgia Tech. Fu's research interests involve developing novel algorithms and data analysis strategies for capturing highly reproducible brain biomarkers. He is also investigating how brain disorders contribute to abnormalities in brain dynamics. His academic training and research experience have provided him with an excellent background in signal processing and computational neuroscience. The human brain is a highly dynamic system characterized by non-stationary neural activities and represented by changing psycho-physical states and mental functions. Identifying brain dynamics from complex neuroimaging signals and exploring the functional relevance of brain dynamics has gained increasing popularity for it is essential for understanding how the brain is organized to support cognitive and affective processes as well as utilization of brain dynamics in neural engineering and clinical applications. Dr. Fu's current work is concentrating on a "Neuromark" project, which aims to understand the unique and common mechanisms among neuropsychiatric and neurodegenerative disorders. This project enables the investigation of how different brain biomarkers contribute to the underlying mechanisms in a wide range of brain diseases.