



Dr. Taotao Wu

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11:30am - 1:00pm

CKB 303

Traumatic Brain Injury: Brain Network under Biomechanical Attack

Abstract:

The mechanisms that underlie complex brain function and cognition remain a mystery. Traumatic brain injury (TBI), a disorder caused by external forces, offers a unique opportunity to uncover these mechanisms. From the perspective of network theory, cognitive function is driven by dynamic interactions between large-scale neural circuits or networks, while brain dysfunction after TBI is caused by desynchronized rhythms when the brain network and its supporting system are under attack. However, current research faces significant challenges in understanding the complexity and heterogeneity of TBI. In this study, an interdisciplinary computational TBI model was developed that integrates a brain mechanics model with linked models of neurodynamics (Kuramoto oscillator) and vascular perfusion (Balloon-Windkessel) to understand how an impact can alter the function of brain networks. Concussion-prone scenarios were identified through a multi-dimensional exploration of impact directions, brain morphology, and network architectures. The model was further upgraded with a resource-constrained neurodynamic model to show how energy disruption after TBI can cause brain dysfunction and the potential differences in injury susceptibility due to neurovascular heterogeneity.

About the Speaker

Dr. Taotao Wu is a Postdoctoral Fellow in the Bioengineering Department at the University of Pennsylvania. His research centers on utilizing computational models, animal models, and human data to gain a comprehensive understanding of traumatic brain injury and its treatment. Through his postdoctoral research in Dr. David Meaney's lab, Dr. Wu has developed a unique approach that combines principles in injury biomechanics, finite element analysis, network neuroscience, and neuroimage analysis to bridge the gap between the mechanical response and brain functional response during TBI. Over his career, Taotao has been awarded multiple honors and awards, including the Outstanding Research Presentation award of the Year and Outstanding Graduate Student Award from the University of Virginia.