Emergence of Synchronization Patterns in Neuronal Networks: A Focus on Central Pattern Generators in Insect locomotion

Abstract:

Synchronization refers broadly to patterns of coordinated behaviors that emerge spontaneously or by design in natural and artificial complex network systems and are crucial for reliable functioning in such networks. Achieving stable and robust synchronization relies on the dynamics of individuals, properties of their connections, exogenous control inputs, and the network’s topology. In this seminar, we will explore Central Pattern Generators (CPGs), neural networks responsible for coordinating activities like walking. We will begin by introducing a mathematical model for CPGs and use this framework to investigate the emergence of various stable and robust synchronization patterns. These patterns correspond to distinct locomotion gait patterns, and we will discuss how they transition from one to another. Additionally, our discussion will encompass the prediction and mitigation of pathological gait patterns within the model. We will showcase how adjustments to the model can eliminate these abnormal locomotion patterns, shedding light on potential therapeutic applications.

Bio:

Dr. Zahra Aminzare is an Assistant Professor in the Department of Mathematics at the University of Iowa, with affiliations in the Applied Mathematical and Computational Sciences Program and The Interdisciplinary Graduate Program in Neuroscience. She is also a member of The Iowa Neuroscience Institute. Dr. Aminzare’s research interests are centered around the intersection of applied dynamical systems, partial differential equations, and mathematical biology. Specifically, her work focuses on contraction theory and synchronization patterns in biological systems. Before joining the University of Iowa, Dr. Aminzare served as a Postdoctoral Research Associate at PACM, Princeton University, from 2015 to 2018. She completed her Ph.D. in Mathematics at Rutgers University in 2015.