PhD Oral Defense

Date: **19 August 2020 (Thursday)** **Time:** **2:30pm**

Thesis Title

Network Modelling and Functional Graph Structure of the Primary Visual Cortex

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Abstract

Biological vision is a fast, flexible, and energy-efficient sensing system. Understanding how biological vision systems achieve their characteristic combination of speed, flexibility, and energy-efficiency can provide insights for improving computer vision systems and assistive technologies. One limiting factor of this line of research is a bias in the literature towards neuronal-level descriptions that obfuscate the network-level computational structure of the mammalian visual system. No neuron functions in isolation: neural networks code information through coordinated behavior. Calcium imaging can now simultaneously record larger populations than previous techniques, allowing single-neuron analyses to be expanded to the network level. Larger datasets demand the development of computational approaches for network-level analysis. Graph theory, which conceptualizes networks as series of nodes interacting via edges, can elucidate important network properties. However, for the foreseeable future there still exists a subsampling in neuroscience experimentation. This subsampling problem motivates development of latent variable models that can infer unobserved brain function. Taken together, the need for a network-level understanding of biological visual systems and the experimental limitations of small sample sizes, positions graph theory and latent variable models in synergistic roles for advancing computational neuroscience. This thesis utilized a large dataset of recordings from the murine visual cortex, made available by the Allen Brain Institute, to characterize the network properties of, and extract meaningful latent features from, the biological vision system. This defense presentation will elucidate insights gained from network analysis and latent variable modelling of the visual cortex. These insights generated testable hypotheses that have already proven useful in the development of computer vision and assistive technologies.