SEMINAR NOTICE

Preston M. Green Department of Electrical and Systems Engineering

An Adaptive Computation in an Olfactory Circuit

PhD Preliminary Research Examination

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Abstract: Sensory stimulus evokes complex spiking activities patterned across neurons and time that are thought to encode its identity and intensity. Since the same stimulus can be encountered in a multitude of ways, how does the sensory system robustly encode the stimulus-specific information? We seek to address this important question of neural coding using the locust olfactory system. In the antennal lobe, a neural circuit directly downstream to the olfactory sensory neurons, we find that both the spatial and temporal features of the odor-evoked responses vary in a stimulus-history dependent manner. These response variations are not random, but allow the antennal lobe circuit to enhance the uniqueness of the current stimulus (i.e. perform a contrast enhancement computation). Nevertheless, information about the odorant identity is confounded due to this contrast-enhancement computation. In this study, we propose that a simple, linear logical classifier (OR-of-ANDs) can decode information distributed in flexible subsets of neurons. The decoder predictions tightly match with the results from our behavioral experiments. Our results suggest that a trade-off between stability and flexibility in sensory coding can be achieved using a simple computational logic. Furthermore, we study the underlying mechanisms at the network-level and at the individual neuron-level that facilitates these adaptive computations. Specifically, we study the role of recurrent inhibition provided by the inhibitory local neurons and develop well-constrained models of these early olfactory circuits to bridge the gap between the mechanistic and phenomenological experimental observations. In sum, our results will provide a comprehensive understanding of how a relatively simple invertebrate olfactory circuit could perform complex adaptive computations with simple individual components.

DATE: Tuesday, December 11, 2018
TIME: 2:00 p.m.
PLACE: Green Hall, Room 0120

Dissertation advisor:
Dr. Baranidharan Raman

This seminar is in partial fulfillment
of the Doctor of Philosophy degree

Washington University in St. Louis
School of Engineering & Applied Science