SCHOOL OF INFORMATICS AND COMPUTING

Intelligent Systems Engineering Colloquium Series

Eatai Roth

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4 PM

Geology Building
GY-S201

The Control of Insect Flight: A Confound of Sensory Feedback in Nature and the Laboratory

Abstract: Animals are remarkably adept at acquiring and processing information used to negotiate and interact with complex environments. Animal sensory systems have inspired engineered sensors (e.g., insect-inspired cameras, capacitive ``hair cell" strain sensors, etc.) and, similarly, the influence of biology is evident in the design of many robots and manipulators (e.g., tendon driven actuators, compliant systems, legged and soft robotics, etc.). However, many of the dynamical properties of animal movement (e.g., stability, robustness, redundancy, adaptation) emerge from the interaction between neural and mechanical subsystems as well as the physical interaction between the animal and its environment. This work aims at understanding the high-level control architectures by which animals integrate information across different sensory modalities to regulate locomotion. Broadly, my research seeks generalizable and translational principles of biological control.

This talk explores the sensory control of flight behaviors in insects, specifically, object-following behaviors in the fruit fly, Drosophila melanogaster, and the hawk moth, Manduca sexta. Translating tools from control and system identification theories, I introduce experimental and analytical methods for modeling the dynamics and sensorimotor control of animal movement. I discuss how these models inform our understanding of sensory feedback in natural behavior and how experiment design shapes behavior in the laboratory, sometimes in confounding and unintuitive ways. I end with a discussion of ongoing and future work, presenting a vision of how these methodologies and models can be refined towards reconciling our understanding of neural computation and biomechanical dynamics with the behavioral phenomena they bring about.

Biography: Eatai Roth is trained in both engineering and biology and has been working at the interface of these domains for the past ten years. Eatai earned his PhD in Mechanical Engineering from Johns Hopkins University in 2012 advised by Noah Cowan (LIMBS Lab, an affiliated lab of the Laboratory for Computational Sensing and Robotics). He is currently a postdoctoral researcher in the Department of Biology at the University of Washington, advised by Tom Daniel, where he investigates the sensorimotor control of flight in insects. He is the recipient of the WRF Innovation Postdoctoral Research Fellowship in Neuroengineering and is joint fellow of the UW Institute for Neuroengineering and the Air Force Center of Excellence on Nature-Inspired Flight Technologies and Ideas. In addition, he received graduate awards from the National Science Foundation and the ARCS Foundation. Eatai has taught and assisted in courses in both engineering (Electronics and Instrumentation, Linear Systems, System Identification at Johns Hopkins) and biology (Neural Systems and Behavior summer course at the Marine Biological Laboratory, Biomechanics at UW). His research and teaching melds ideas and approaches from engineering, biology, and neuroscience towards understanding the dynamics and control of animal movement. Also, a long time ago, Eatai received his Bachelors of Fine Arts in Painting and Art History from Washington University in St. Louis; he still doodles, barely.

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