



# Washington University in St. Louis

## SCHOOL OF ENGINEERING & APPLIED SCIENCE

Preston M. Green Department of Electrical & Systems Engineering

### Seminar Announcement

**Max Berniker**

Assistant Professor

Department of Mechanical & Industrial Engineering

University of Illinois, Chicago



Thursday, February 22, 2018

Green Hall, Room 0120 (Rodin Auditorium)

1:00 P.M.

### Title: A Normative Approach to Neuromotor Control

**Abstract:** While we can readily observe and model the dynamics of our limbs, analyzing the neurons that drive movement is not nearly as straightforward. As a result their role in motor behavior (e.g. forward models, state estimators, controllers, etc.) remains elusive. Computational explanations of electrophysiological data often rely on firing rate models or deterministic spiking models. Yet neither can accurately describe the interactions of neurons that issue spikes, probabilistically. Here we take a normative approach for examining of the neural role in motor control, by designing a probabilistic spiking network to implement LQR control for a limb model. We find typical results: cosine tuning curves, population vectors that correlate with reaching directions, low-dimensional oscillatory activity for reaches that have no oscillatory movement, and changes in neuron's tuning curves after force field adaptation. Importantly, we can also analyze it in terms of the known causal mechanism: an LQR controller and the probability distributions of the neurons that encode it. We suggest this normative approach can be used to analyze candidate control hypotheses for the motor system, providing testable links between observed neural activity and motor behavior.

**Bio:** Max Berniker is a controls engineer specializing in reverse engineering the central nervous system, focusing on motor control in humans and animals. With a background in controls, system dynamics, biomechanics and neuroscience, he has worked across many modeling domains, from robotics to muscle modeling, and many experimental settings, from robot-assisted rehabilitation to human psychophysics to animal model studies. Overall, his research aims to illuminate the workings of the motor system for the benefit of basic science and for individuals with motor disabilities.

**Host: ShiNung Ching**