The Chinese University of Hong Kong
Department of Biomedical Engineering

Computational approaches to neuromuscular learning in animals and robots

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Time : 4:00pm
Venue : ERB1122, William M W Mong Engineering Building, CUHK

Abstract

Lifelong learning is a defining factor of neural systems. Understanding the mechanisms by which animals learn quickly, autonomously and driven by their own limited experience would empower approaches to behavior, disability and rehabilitation. This knowledge can also drive the emerging field of bio-robotics. We are developing "robots with a nervous system " by selecting fundamental neurophysiological mechanisms-as understood today-and implementing them as physiologically-faithful algorithms and circuits. I will present examples ranging from high-level algorithms for autonomous learning of locomotor and dexterous manipulation, to low-level spinal circuits for muscle tone and stretch reflexes. This will highlight the importance of brain-body co-evolution in biological systems that holds valuable lessons for robotics based on the co-design of learning algorithms, neuromorphic controllers and bio-inspired bodies.

References: Valero-Cuevas FJ, Erwin A Nature Machine Intelligence, 2022; Kudithipudi D, et al. Nature Machine Intelligence, 2022; Hagen DA et al. Frontiers in Neurorobotics, 2021; Berry JA, Valero-Cuevas FJ. Artificial Life Conference Proceedings, 2020; Marjaninejad A, et al. Nature Machine Intelligence, 2019

Biography

I attended Swarthmore College from 1984-88 where I obtained a BS degree in Engineering. After spending a year in the Indian subcontinent as a Thomas J Watson Fellow, I joined Queen's University in Ontario and worked with Dr. Carolyn Small. The research for my Master's Degree in Mechanical Engineering at Queen's focused on developing non-invasive methods to estimate the kinematic integrity of the wrist joint. In 1991, I joined the doctoral program in the Design Division of the Mechanical Engineering Department at Stanford University. I worked with Dr. Felix Zajac developing a realistic biomechanical model of the human digits. This research, done at the Rehabilitation R & D Center in Palo Alto, focused on predicting optimal coordination patterns of finger musculature during static force production. After completing my doctoral degree in 1997, I joined the core faculty of the Biomechanical Engineering Division at Stanford University as a Research Associate and Lecturer. In 1999, I joined the faculty of the Sibley School of Mechanical and Aerospace Engineering at Cornell University as Assistant Professor, and was tenured in 2005. In 2007, I joined the faculty at the Department of Biomedical Engineering, and the Division of Biokinesiology & Physical Therapy at the University of Southern California as Associate Professor; where I was promoted to Full Professor in 2011. In 2013 I was elected Senior Member of the IEEE, and in 2014 to the College of Fellows of the American Institute for Medical and Biological Engineers. In 2018, I was awarded an Honorary Doctorate in Biology from Swarthmore College, and in 2023 I was inducted into the National Academy of Inventors.

***** ALL ARE WELCOME *****

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