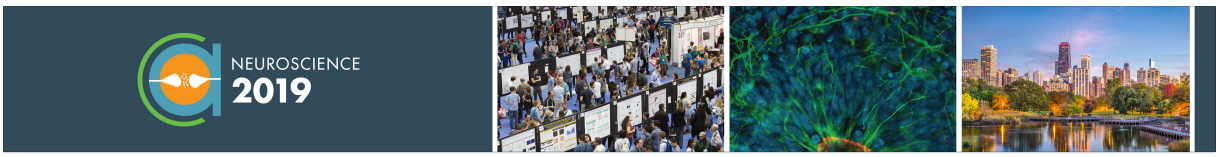

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Session 421 - Human Learning: Feedback, Reinforcement, and Reward

Add to Itinerary

421.13 / AA8 - Bioinspired few-shot learning in robotic systems

October 21, 2019, 1:00 PM - 2:00 PM | Hall A

Session Type
Poster

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Abstract
The vast majority of robotic systems in use today rely on hard-coded lookup tables and prescribed trajectories, amounting to little more than error correction. In the context of simulation, some robots are able to 'dream' of new tasks, and apply what they've learned from simulations in the real world. However, animals (or any physical system in general) do not have the convenience of excessive trial and error processes or unlimited simulations to learn how to move, manipulate, and navigate. As commonly used control algorithms sacrifice versatility, robustness, and generality across a wider set of tasks in favor of precision in just a few, what insights from biology can be brought to robotics? We present a bioinspired hierarchical learning approach [1] which, for the first time, demonstrates autonomous learning of different movement patterns in a bio-plausible tendon driven limb. In spite of the limb being an under- and over-determined control problem at the same time [2], it takes only a few minutes of interaction with the environment for our control system to achieve a challenging precision task. This bio-inspired learning approach (both in learning and physical implementation) enable our system to learn how to control its motor activation patterns to propel a passive treadmill in as short as about 10 minutes on average and led to the formation of 'movement habits/personalities" across independent runs. This line of research (as well as a comparison to traditional methods such as genetic algorithms [3]) can revolutionize the utility of modern robots, as they could functionally resemble vertebrates in both anatomy and physiology (including learning and decision making). Our work sets forth a path for robots to interact with humans and other elements in the environment to learn to act properly in unforeseen scenarios [1]. The interplay of self-learning robotics and soft-body physics may ultimately uncover new insights in the fields of biomechanics and neuroscience and we discuss the implications of such research.
[1] marjaninejad et. al., 2019, nature machine intelligence; [2] marjaninejad and Valero-cuevas, 2019, Biomechanics of Anthropomorphic Systems; [3] marjaninejad et. al. IEEE EMBC 2018

Abstract Citation