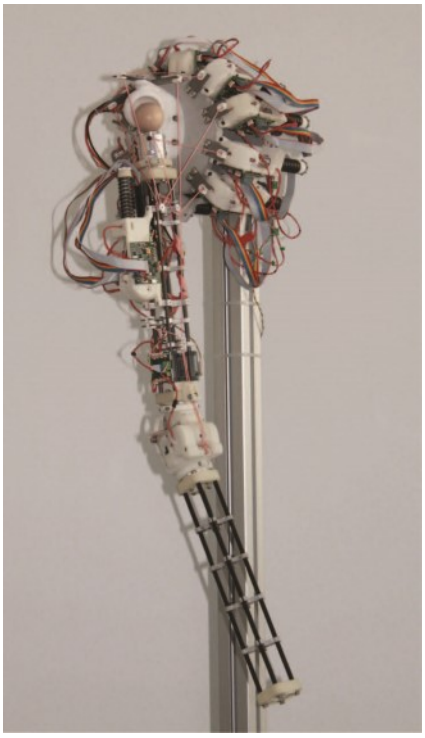
Robotics and Embedded Systems

Human Brain Project

Bachelor Thesis - Master Thesis - Semester Project

Spiking Compliant Robot Control with Intel Loihi

BACKGROUND



Musculoskeletal robots mimic the biomechanical properties of the musculoskeletal systems of vertebrate animals. Unlike standard industrial robots, they have redundant degrees of freedom for maximum dexterity and a compliant structure that makes them safe and robust. Controlling compliant biomimetic robots is still an unsolved problem and a highly promising field of application for spiking neural networks. The goal of this project is to connect the neuromorphic chip Loihi developed by Intel [1] to a single-joint biomimetic robot arm to perform real-time closed-loop control with online learning. The arm will learn to follow a set of pre-defined trajectories without any dynamic models based on a spiking neuron model of the cerebellum that leverages the spike trace-based learning framework of Loihi [2].

YOUR TASK

You will implement a spiking neural network model with support for online learning of the cerebellum on Loihi and evaluate on a simulated Myorobotics system.

REQUIRED SKILLS

- Basic knowledge of neural networks
- Programming experience in robotics
- Good knowledge of Python

FURTHER READING

[1] M. Davies *et al.*, "Loihi: A Neuromorphic Manycore Processor with On-Chip Learning," *IEEE Micro*, vol. 38, no. 1, pp. 82–99, 2018.

[2] C. Richter *et al.*, "Musculoskeletal Robots: Scalability in Neural Control," *IEEE Robot. Autom. Mag.*, no. August, 2016.

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