Technische Universität München
Neurowissenschaftliche Systemtheorie

Engineering Practical Project

Online Demonstration of Spike-Based EEG Decoding on SpiNNaker Neuromorphic Hardware

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Problem description:

SpiNNaker [1] is a neuromorphic hardware which uses a highly parallel brain-inspired architecture to simulate large spiking neural networks (SNNs). In [2], we implemented a spiking neural network inspired from the architecture of the olfactory system of insects to decode motor imagery movements from EEG signals. The decoding algorithm runs on SpiNNaker hardware and performs its computations in a purely spike-based fashion. In that work, we successfully demonstrated the offline classification of two motor imagery movements with a mean accuracy of 76%. However, no online demonstration has been shown yet. Therefore, the main objective of this project is to test our recently developed SNN algorithm on SpiNNaker in an online scenario (live data streaming, read/send spikes online). Thereafter, the complete system comprising the decoding algorithm running on SpiNNaker, Katana robot arm and our G-Tec EEG system shall be demonstrated in a real-time scenario.

Tasks:

This practical project requires the student to:

- EEG-SpiNNaker interface for reading/sending spikes online + live streaming of recorded EEG data
- Working live demonstration of a system comprising SpiNNaker, EEG system and Katana robot arm.

Bibliography:

[1] Xin Jin, Alexander Rast, Francesco Galluppi, Mukaram Khan and Steve Furber "*Implementing Learning on the SpiNNaker Universal Neural Chip Multiprocessor"*, Neural Information Processing, Vol: 5863, pp. 425-432, 2009

[2] Zied Tayeb, Emeç Erçelik, and Jörg Conradt, "*Decoding of Motor Imagery Movements from EEG Signals using SpiNNaker Neuromorphic Hardware"*, 8th IEEE International Conference on Neural Engineering (IEEE EMBS), 2017

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