

A biologically inspired decision network: the basal ganglia model running on neuromorphic hardware

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Neuromorphic computing has emerged in recent times as an alternative paradigm to classical computing. It incorporates features of both digital and analog computing to build systems of biologically inspired individual neurons that can pass spikes to each other on a network. This results in scalable algorithms and hardware architectures with localized memory and sparse computing and communication needs, that are very efficient and exhibit low power consumption.

In this poster, we use the boards of the neuromorphic hardware architecture SpiNNaker-2, available at NHR@Göttingen, to implement the biologically inspired basal ganglia model network. This model is a simplified version of the decision making pathway of the brain, able to solve the go/no-go task of selecting between two competing impulses depending on incoming stimuli. We analyze its behavior and usefulness as a case study for decision networks, and evaluate the efficiency and power consumption of different versions of the network.

We believe these results, with a focus on decision mechanisms, simulation, and biologically-inspired digital twins, will be of interest to the HPC-Driven Decision Science topic track. Of additional relevance to this track, the poster will serve as an introduction to neuromorphic computing at large and the SpiNNaker hardware architecture in particular, which can be used in a variety of optimization algorithms, to simulate graph-like systems such as energy grids and transport networks, or to study biological learning, among various other applications. This contribution will also be of interest to the Mixed Precision Computing topic track, given the numerical limitations of the ARM-based SpiNNaker hardware architecture, and we will showcase the challenges faced in this regard when setting up a neuromorphic simulation, as well as the necessary workarounds.