SpiNNaker – a neural simulation engine

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Abstract:

SpiNNaker is a completely novel kind of computing architecture, which bears little or no resemblance to Turings original concept of sixty years ago. It was intended, designed and optimised for the problem of neural simulation, but on a scale and at a speed unattainable with conventional machines. The headline goal is to be able to simulate the behaviour of a billion neurons *in real time*, using a million conventional cores. As neural ensembles become ever more complex, amongst the technical challenges facing the human experimenter is that of interpreting the output: a billion time histories is a formidable mass of data to mine. Received neuroscience wisdom says that the best way to study the high-level behaviour of a large neural ensemble is to embed it in a virtual reality environment, where complex emergent behaviour can be (relatively) easily identified and manipulated. To achieve this requires that the simulation is capable of reacting to stimuli in real time, and this is just what SpiNNaker is designed to do.

In this seminar, we present a brief outline of the architecture of the machine, followed by a more detailed description of the specialised approach used within it to integrate (neural) differential equations. We go on to show how this produces biologically realistic behaviour, orders of magnitude faster than that obtainable with conventional architectures.

Finally, we briefly present some performance data, and discuss the limitations of this technique and its implementation.

Two research questions SpiNNaker is intended to illuminate:

- ***How can massively parallel computing resources accelerate our understanding of brain function?***

- ***How can our growing understanding of brain function point the way to more efficient parallel, fault-tolerant computation?***