**A Neuromorphic Compute Node Architecture for Reproducible Hyper-Real-Time Simulations of Spiking Neural Networks**

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|  | Neuromorphic compute node high-level architecture and its performance characteristics in comparison with NEST. |

Despite the great strides neuroscience has made in recent decades, the underlying principles  
of brain function remain largely unknown. Advancing the field strongly depends on the ability to  
study large-scale neural networks and perform complex simulations. In this context, simulations  
in hyper-real-time are of high interest, but even the fastest supercomputer available today is not able to meet the challenge of accurate and reproducible simulation with hyper-real acceleration. The development of novel neuromorphic computer architectures holds out promise. Advances in System-on-Chip (SoC) device technology and tools are now providing interesting new design possibilities for application-specific implementations. We propose a novel hybrid software-hardware architecture approach for a neuromorphic compute node intended to work in a multi-node cluster configuration [1]. The node design builds on the Xilinx Zynq-7000 SoC device architecture that combines a powerful programmable logic gate array (FPGA) and a dual-core ARM Cortex-A9 processor extension on a single chip [2]. Although high acceleration can be achieved at low workloads, the development also reveals current technological limitations that also apply to CPU implementations of neural network simulation tools.

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References

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2. Zynq-7000 SoC Technical Reference Manual (UG585). Available online at: www.xilinx.com.