SENSIM: An Event-driven Parallel Simulator for Multi-core Neuromorphic Systems

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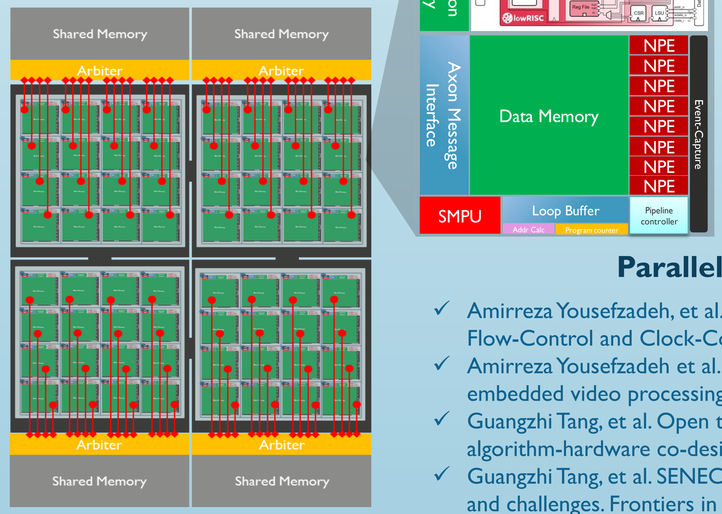
Abstract

In this paper, we present SENSIM, which is an open-source simulator designed specifically for the SENECA neuro-morphic processor. This simulator is unique in that it combines features from both hardware-specific and hardware-agnostic spiking neural network simulators, resulting in a hybrid event- driven and time-step-driven simulation approach. This allows for flexibility between accuracy and speed during different stages of simulation. Our work highlights the open-source SENSIM platform, which enables the mapping of large-scale SNN/DNN models to the SENECA cores, as well as the benchmarking of crucial KPIs such as power and latency estimation.

Objectives

- ✓ Open-source SENECA Simulation Platform
- ✓ Hybrid event-driven Design
- ✓ Scaling up the Flexible SENECA Neuro Synaptic Core
- ✓ Faster design space exploration and energy/latency estimation
- ✓ Easy Integration with SNN/DNN models
- ✓ Customization for Future Research

SENECA



Parameters

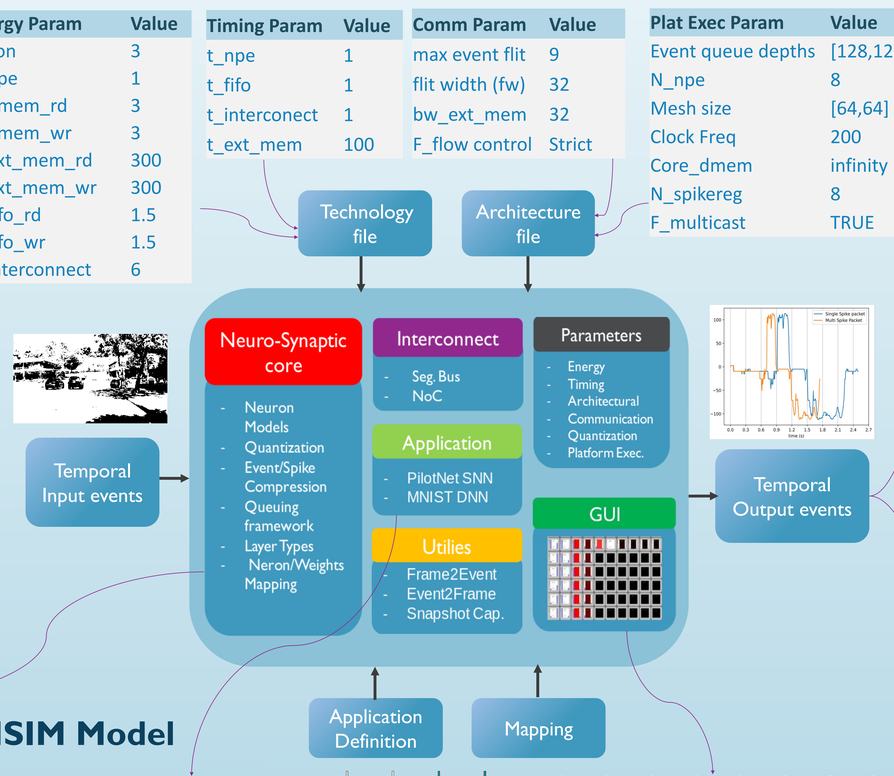
Energy Param	Value
e_con	3
e_npe	1
e_dmem_rd	3
e_dmem_wr	3
e_ext_mem_rd	300
e_ext_mem_wr	300
e_fifo_rd	1.5
e_fifo_wr	1.5
e_interconnect	6

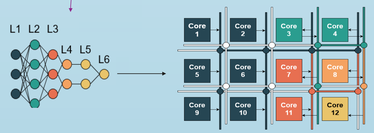
Timing Param	Value
t_npe	1
t_fifo	1
t_interconect	1
t_ext_mem	100

Comm Param	Value
max event flit	9
flit width (fw)	32
bw_ext_mem	32
F_flow control	Strict

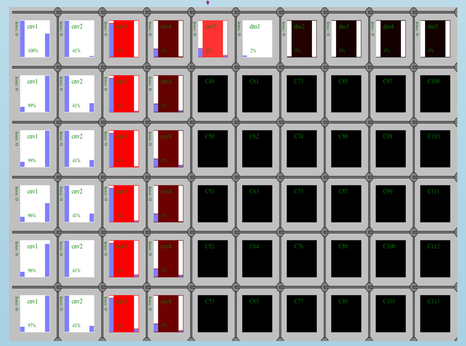
Plat Exec Param	Value
Event queue depths	[128,128]
N_npe	8
Mesh size	[64,64]
Clock Freq	200
Core_dmem	infinity
N_spikereg	8
F_multicast	TRUE

SENSIM Model

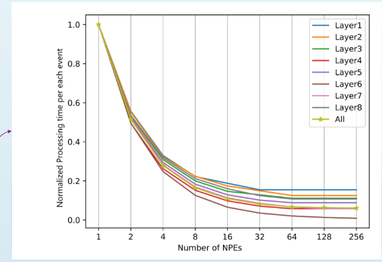


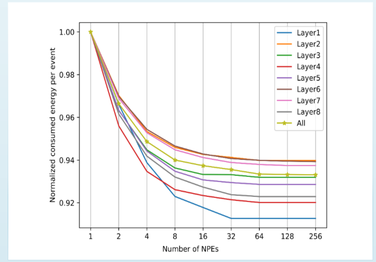


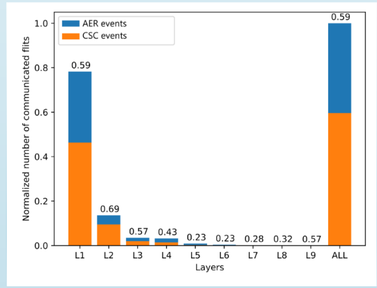
SENSIM GUI

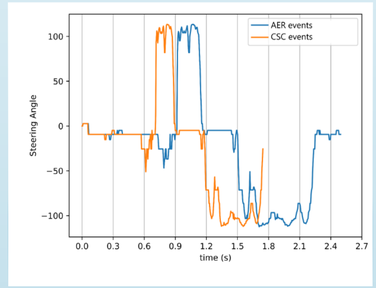


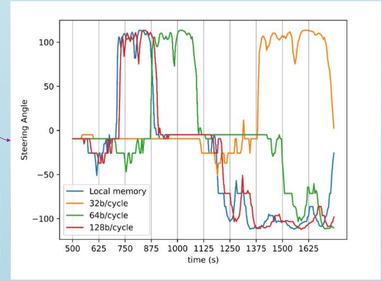
Experimentation & Results

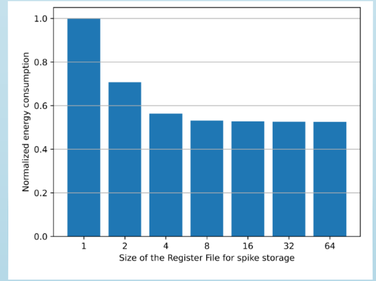












Parallel research & References

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- ✓ Guangzhi Tang, et al. Open the box of digital neuromorphic processor: Towards effective algorithm-hardware co-design, March 2023. arXiv:2303.15224
- ✓ Guangzhi Tang, et al. SENECA: building a fully digital neuromorphic processor, design trade-offs and challenges. Frontiers in Neuroscience, 17, 2023

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