



Bio-inspired computation: clock-free, grid-free, scale-free, and symbol free

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“Bio-inspired computation: Clock-free, grid-free, scale-free, and symbol-free”

18 September 2015

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See the list of publications for full details.

Introduction: The objective of this project was to develop new forms of computation, free from clock-based synchrony, grid-based spatial structures, able to operate across multiple scales (scale-free) and able to infer symbolic information from sensory-motor streams that have no pre-determined symbols.

Experiment: Complete details of the methods are in the published papers listed below. The DVS128 lens is frameless (pixel changes are sent asynchronously, which mimics the action of a biological retina, sending spikes only when the image changes, and only for pixels which register a change. The new sensor enables us to test spiking neural models with spike-like sensory data. This new data format requires changing the computational paradigm from conventional (clock-based and uniform-scale) computation to a much more robust and adaptive form (clock-free and scale-free).

Results and Discussion:

The network was tested on a high dimensional prediction task (16,384 pixels from DVS video data). Simulations compared the new prediction neurons to a conventional iterative paradigm on motion sequences: the new approach has much lower error within its prediction range.

List of Publications and Significant Collaborations that resulted from your AOARD supported project:

- a) Peer-reviewed journals: none to date
- b) Peer-reviewed conferences:

Gibson, T, Henderson, JA and Wiles, J. "Event-Based Visual Data Sets for Prediction Tasks in Spiking Neural Networks." Artificial Neural Networks and Machine Learning–ICANN 2014. Springer, 2014. pp 635-642.

Gibson, T, Henderson, JA and Wiles, J. "Predicting temporal sequences using an event-based

spiking neural network incorporating learnable delays." IEEE International Joint Conference on Neural Networks (IJCNN), 2014.

c) Non-peer-reviewed journals and conference proceedings:

Gibson, T, Henderson, JA and Wiles, J. "Finding Structure in Spikes" presented at NeuroEng, the 7th Australian Workshop on Computational Neuroscience, Adelaide (2014 Jan).

Henderson, JA, Gibson, T, and Wiles, J. "Deep Polynchroty networks" presented at NeuroEng, the 7th Australian Workshop on Computational Neuroscience, Adelaide (2014 Jan).

Gibson, T and Wiles, J "Predicting temporal sequences using an event-based spiking neural network incorporating learnable delays" at the University of Queensland Engineering Postgraduate Conference, Brisbane, Australia (2014 June).

d) Conference presentations without papers: none

e) Manuscripts submitted but not yet published:

Henderson, JA, Gibson T, and Wiles, J. "Spike Event Based Learning in Neural Networks." arXiv preprint arXiv:1502.05777, under review (submitted 2015).

Gibson T, and Wiles, J. "Thinking in light-cones: A novel metric for processing DVS event data using speed-based clustering", under review (submitted 2015).

f) Interactions with industry or with Air Force Research Laboratory scientists or significant collaborations that resulted from this work: None to date.

Attachments: Publications a), b) and c) listed above.