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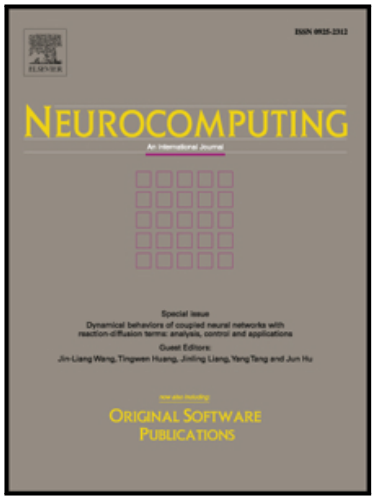


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# An Efficient Method for online Detection of Polychronous Patterns in Spiking Neural Networks

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**Abstract**

Polychronous neural groups are effective structures for the recognition of precise spike-timing patterns but the detection method is an inefficient multi-stage brute force process that works off-line on pre-recorded simulation data. This work presents a new model of polychronous patterns that can capture precise sequences of spikes directly in the neural simulation. In this scheme, each neuron is assigned a randomized code that is used to tag the post-synaptic neurons whenever a spike is transmitted. This creates a polychronous code that preserves the order of pre-synaptic activity and can be registered in a hash table when the post-synaptic neuron spikes. A polychronous code is a sub-component of a polychronous group that will occur, along with others, when the group is active. We demonstrate the representational and pattern recognition ability of polychronous codes on a direction selective visual task involving moving bars that is typical of a computation performed by simple cells in the cortex. By avoiding the structural and temporal analyses of polychronous group detection methods, the computational efficiency of the proposed algorithm is improved for pattern recognition by almost four orders of magnitude and is well suited for online detection.

*Keywords:* Polychronization, Neural Code, Spiking Neural Networks, Pattern Recognition
*2017 MSC:* 00-01, 99-00

## 1. Introduction

Spiking neurons [1] present quite a different paradigm to those of artificial neural networks that work directly on real valued variables [2]. Often, investigators choose to decode the spiking activity using various methods [1] into real values such that they can be used with traditional regression and classification algorithms [3].

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