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Brain Inspired Enhanced Learning Mechanism Based on Spike Timing Dependent Plasticity (STDP) for Efficient Pattern Recognition in Spiking Neural Networks

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ABSTRACT

Artificial neural networks, that try to mimic the brain, an active area of research today. Such networks can potentially solve difficult problems such as image recognition, video analytics, lot more energy efficiently than when implemented in standard von-Neumann computing machines. New algorithms for neural computing with high bio-fidelity are being developed today to solve hard machine learning problems. In this work, we used a spiking network model, and implemented a self-learning technique using a Spike Timing Dependent Plasticity (STDP) algorithm, that closely mimics the neural activity of the brain. The basic STDP algorithm modulates the synaptic weights interconnecting the neurons based on pairs of pre- and post-synaptic spikes. This ignores the timing information embedded in the frequency of the post-synaptic spikes. We calculated the average of post-synaptic neuron that is dependent on its spike frequency to determine if a weight update needs to be carried out. The resultant synaptic updates are less frequent and made wisely making the learning process better. With the present algorithm, we are able to achieve an accuracy of 79% for identifying images from the MNIST data set classifying 400 output neurons. So the model was able to identify 79% of the total images correctly which is greater than the original 69% signifying that slow and sensible updates are definitely having a better impact on the learning process.

KEYWORDS

Spiking Neural Network, Spike Timing Dependent Plasticity, STDP, Machine Learning