A self-organising spiking neural network trained using delay adaptation

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Abstract

This paper proposes a self-organising delay adaptation spiking neural network model for clustering control chart patterns. This temporal coding spiking neural network model employs a Hebbian-based rule to shift the connection delays instead of the previous approaches of delay selection. Here the tuned delays compensate the differences in the input firing times of temporal patterns and enables them to coincide. The coincidence detection capability of the spiking neuron has been utilised for pattern detection. The structure of the network is similar to that of a Kohonen's Self-Organising Map (SOM) except that the output layer neurons are coincidence detecting spiking neurons. An input pattern is represented by the neuron that is the first to fire among all the competing spiking neurons. Clusters within the input data are identified with the location of the winning neurons and their firing times. The proposed spiking neural network has been utilised to cluster SPC control chart patterns. The trained network obtained an average clustering accuracy of 96.1% on previously unseen test data. This was achieved with a network of 8x8 spiking neurons trained for 20 epochs containing 1000 training examples. The clustering accuracy of the proposed model was found to be better than that of Kohonen's SOM.

Indexed keywords

Engineering controlled terms: Chlorine compounds; Cluster analysis; Coincidence circuits; Electronics industry; Flow of solids; Flowcharting; Image classification; Industrial electronics; Military operations; Neurons; Programming theory; Strength of materials; Technical presentations

Engineering uncontrolled terms: Clustering accuracy; Clustering control; Coincidence detection; Control Chart Patterns; Firing times; Input data; Input patterns; International symposium; Kohonen; Output layers; Pattern detections; Self-organising map; Spiking neural network; Spiking neurons; Temporal coding; Temporal patterning; Test data; Trained network

Engineering main heading: Neural networks