Control chart pattern clustering using a new self-organizing spiking neural network

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Abstract

This paper focuses on the architecture and learning algorithm associated with using a new self-organizing 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 utilized for pattern clustering. The structure of the network is similar to that of a Kohonenselforganizing 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 self-organized delay adaptation spiking neural network (SODA_SNN) has been utilized to cluster control chart patterns. The trained network obtained an average clustering accuracy of 96.1 per cent on previously unseen test data. This was achieved with a network of 8 × 8 spiking neurons trained for 20 epochs containing 1000 training examples. The improvement in clustering accuracy achieved by the proposed SODA_SNN on the unseen test data was twice as much as that on the training data when compared to the SOM.

Author keywords

Hebbian learning; Self-organizing map; Spiking neural networks; Temporal coding

Indexed keywords

Engineering controlled terms: Clustering algorithms; Coincidence circuits; Conformal mapping; Flow of solids; Flowcharting; Image classification; Intelligent agents; Learning algorithms; Learning systems; Military operations; Neurons; Programming theory; Strength of materials; Test facilities; Vegetation

Engineering uncontrolled terms: Cluster controls; Clustering accuracies; Clustering controls; Coincidence detections; Control Chart Patterns; Firing times; Hebbian learning; Input datums; Input patterns; Kohonenselforganizing maps; Output layers; Pattern clustering; Self-organizing; Self-organizing map; Spiking neural networks; Spiking neurons; Temporal coding; Temporal patterns; Test datums; Trained networks; Training datums; Training examples; Winning neurons

Engineering main heading: Neural networks