Benchmarking the Spike-Based Visual Classifications

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ABSTRACT

To have a better understanding of the brain and to build biologically-inspired computers, there is an increasing attention to the research on spike-based neural computation. In terms of the vision field, the visual pathway and its hierarchical organisation have been studied the most within the prime brain. Spiking neural networks (SNNs) which are inspired by its biological structure and functions have been successfully applied to visual recognition/classification tasks. New series of vision benchmarks in the spike-based neural processing are required to quantitatively measure the research progress of this field. Thus a large dataset of spike-based visual stimuli is needed to provide the comparison baseline and a corresponding evaluation methodology is also crucial to assess the accuracy and efficiency of an algorithm.

First of all, according to the current research on spike-based image recognition the input stimuli consist of facial images and digits. All the original images are centre aligned and with similar scale. The database will expand with research development, e.g. moving objects for position-invariant recognition. The output of the data is in Address-Event Representation (AER) format which is well-applied in neuromorphic engineering field. The spike trains of one same image is recorded by different techniques: rate-based Poison spike generator, one spike per pixel and output of a silicon retina with both flashing and jitter input image. Secondly, the evaluation methodology is presented to discuss how to assess the accuracy, speed, efficiency and cost of an algorithm. Finally, a proposed recognition algorithm is tested on the dataset to provide a baseline for comparison.

The benchmark is presented to 1) allow a direct comparison between different algorithms, 2) identify the most promising approaches, 3) assess the state of the art in spike-based visual recognition, 4) identify future directions of research and 5) advance the state of the art.

Keywords: Benchmarking, Neuromorphic Engineering, Real-Time, Spiking Neural Networks, Vision

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