The Johns Hopkins University

Whiting School of Engineering

Department of Electrical and Computer Engineering

Spike-Based Object Detection, Recognition and Tracking

Seminar By

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Abstract:

Imagine having a car that is able to drive itself or a robot that is able to perform tasks ranging from the tedious (e.g. housekeeping) to the dangerous (flying military aircrafts) and even to the difficult (building space stations) without human supervision. This is the stuff of science fiction. Today's robots make certain tasks easier but still require remote supervision and control by humans [1]. Intelligent robots need to be able to interact with objects in their surroundings without human involvement. This involves three steps: (1) detecting the presence of the object, (2) recognizing the object – determining whether it is an obstacle to be avoided, an item to be retrieved, or perhaps a tool required for a particular task [2], and (3) tracking the trajectory of the object – determining how and when to react to it.

While these steps are computationally difficult, humans and other primates are able to perform them easily. They are able to rapidly and effortlessly identify and categorize diverse objects in cluttered scenes under widely varying viewing conditions, such as changes in position, rotation and illumination [3]. Engineered systems are unable to match the level of proficiency and speed of biological visual systems.

Through this thesis, we move towards the development of an autonomous, continuous-time visual system that emulates visual information processing in the primate visual cortex. This multi-stage system will utilize large-scale arrays of identical silicon neurons to build a biologically-plausible model of its biological counterpart. In particular, we will (1) design a neural array transceiver with neurons and synapses that more closely mimic biology, (2) implement silicon facsimiles of cortical simple cells, complex cells, and composite feature cells according to the hierarchical model of primate visual cortex of proposed by Riesenhuber and Poggio, and (3) implement neural algorithms analogous to cross-correlation and Kalman filtering for object detection and tracking respectively.

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CSEB 320

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