Motion Detection Using Spiking Neural Network Model

QingXiang Wu[1,2], T.M. McGinnity[1], Liam Maguire[1], Jianyong Cai[2], and G.D. Valderrama-Gonzalez[1]

[1] Intelligent Systems Research Centre, University of Ulster at Magee Campus
Derry, BT48 7JL, Northern Ireland, UK
{q.wu,tm.mcginnity,lp.Maguire,g.valderrama}@ulster.ac.uk
[2] School of School of Physics and OptoElectronic Technology, Fujian Normal University
Fuzhou, 350007, China
{qxwu,cjy}@fjnu.edu.cn

Abstract. Inspired by the behaviour of the human visual system, a spiking neural network is proposed to detect moving objects in a visual image sequence. The structure and the properties of the network are detailed in this paper. Simulation results show that the network is able to perform motion detection for dynamic visual image sequence. Boundaries of moving objects are extracted from an active neuron group. Using the boundary, a moving object filter is created to take the moving objects from the grey image. The moving object images can be used to recognise moving objects. The moving tracks can be recorded for further analysis of behaviours of moving objects. It is promising to apply this approach to video processing domain and robotic visual systems.

Keywords: Motion detection; spiking neural networks; visual system.

1 Introduction

A football player can promptly perform a series of actions to capture a football when he sees the moving football toward him. The information of the moving football conveys to the brain through the visual system. The retina contains complex circuits of neurons that extract salient information from visual inputs. Signals from photoreceptors are processed by retinal interneurons, integrated by retinal ganglion cells and sent to the brain by axons of retinal ganglion cells. Different cells respond to different visual features, such as light intensity, colour or moving objects [1–5]. Mammalian retinas contain approximately 55 distinct cell types, each with a different function [1]. A retinal cell type responds to upward motion has been identified in [6]. Results in [7] demonstrate that information for segmenting scenes by relative motion is represented as early as visual cortex V1. To detect moving objects, the brain must distinguish local motion within the scene from the global image. The findings in [8] show how a population of ganglion cells selective for differential motion can rapidly flag moving objects, and even segregate multiple moving objects. In [9], it is shown that neurons compute internal models of the physical laws of motion. These findings are shown some principles for the brain to detect moving objects in the psychological or

D.-S. Huang et al. (Eds.): ICIC 2008, LNAI 5227, pp. 76–83, 2008.