A proposal of neuron computer for tracking motion of objects

Hanxi ZHU*, Tomoo AOYAMA**, Ikuo YOSHIHARA

The Faculty of Engineering, Miyazaki University
Gakuen Kibanadai Nishi 1-1, Miyazaki city, 889-2192, Japan
*t0b244u@cc.miyazaki-u.ac.jp, **t0b217u@cc.miyazaki-u.ac.jp

Abstract

We propose a neuron computer for tracking motion of particles in multi-dimensional space. The neuron computer is constructed of neural networks and their connections, which is a simplified model of the brain. The neuron computer is assemblage of neural networks, it includes a control unit, and the actions of the unit are represented by instructions.

We designed a neuron computer to recognize and predict motion of particles. The recognition unit is constructed of neuron-array, encoder, and control part. The neuron-array is a model of the retina, and particles crease an image on the array, where the image is binary. The encoder picks one particle from the array, and translates the particle's location to Cartesian coordinates, which is scaled in [0, 1] intervals. Next, the encoder picks another particle, and does same process. The ordering and reduction of complex processes are executed by instructions. The instructions are held in the control part.

The prediction unit is constructed of a multi-layer neural network and a feedback loop, where real time learning is executed. The particles' future locations are forecasted by coordinate values.

The neuron computer can chase maximum 100 particles that take evasions.

Keywords: *neuron computer, retina, detector, predictor*

1. Introduction

Many researchers have studied architectures for non-Neumann's computers to escape the bottleneck of the computers based on Neumann's architecture. As one kind of the architectures, someone began to develop neuron-based computers. The computers have neurons and their connections that are constructed of the learning. They have information processing facilities, and at the same time, they are like as simplified brains to make inference. The computers are called neuron-computer, however, the name is not recognized yet.

We have a supposition that a neuron-computer is constructed of plural kinds of neural networks [1]. The neuron computer has local structures, then, the neural networks are resources of a neuron-computer. Since neural networks have a learning facility, we don't design the networks, but make them in the learning on use of truth tables. The neuron computer is not plain assemblage of neural networks. It is controlled of the unit, and control-actions of the unit are defined by instructions. The instructions are not that of commercial computer, but micro programs. We introduce the instructions for minimizing hardware of the neural network systems. The computer resources in the neuron-computer should not equal to that of Neumann's computer, but they should have macro functions.

There are logic formulas that can't be represented in the binary operations. They are for multi-value logic, and are evaluated by truth tables, so they can be calculated in neural networks. Therefore, the neuron-computer includes more functions than that of modern computers.

There have been many kinds of recognition models for motion of objects [2]. Many studies of the retina are published particular [3][4]. We wish to make a recognition system to constructed of neuron assemble, and realize it as a neuron-computer including encoder and prediction units.

2. Encoding unit

2.1 Detection of motion

We arrange neurons in multi dimensional mesh, where the dimension number is three. We define a particle as a time dependent function f(x, y, z, t), where the values of f are 0 or 1, and t is clock timing; then, a trace of the particle is defined by f=1, that is written by the series {f(x, y, z; t0), f(x, y, z; t1), ...}. Assemble of the trace is an image in the multi dimensional mesh space, which activates corresponding neurons on the mesh. The activated neuron outputs a signal whose amplitude is 1. The response of non-activated neuron is 0. The binary signals can be got along each coordinate axis, thus, all signals on one axis are summarized, and a signal's vector (group signal) is got. Here, we suppose that the three kinds of vectors for x-, y- and z-coordination's are got. The vector has plural "1" bits, and we call it VE. VE is the projection for Cartesian coordinate of the particles.

To distinguish individual particle's location of the vector, a following flow is necessary. The processing of the flow is implemented by neural network.

FLOW

(1) Set initial vector {1,0,0...0}, which is called MASK.
(2) Do bit wise AND-operations between the vector VE and MASK, and get a vector, that is stored to R.
(3) Do OR-operations for whole elements of R-vector, and get a scalar, that is stored to S.
(4) Judge whether S is 1 or not, if S is 1, the R-vector is stored in vector array RVA. Then:
(4-1) Do bit wise NOT-operations on the R-vector, and get a scalar, that is written by S.
(4-2) Do bit wise AND-operations between the vector