Learning-possibility for neuron model in Medical Superior Temporal area

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Abstract

We propose a neuron model that is possible to learn three-dimensional movement. The neuron model by imitating structure of a neuron, has the system resemble a neuron. We considered a neuron system based on the arguments, and wished to examine whether the system had reasonable function. Koch, Poggio and Torre believed that inhibition signal would shunt excitation signal on the dendrites. They believed that excitation signal operated input-signals and inhibition did as delayed ones. Thus, they were sure that function for directional selectivity was arisen by the shunting. Koch's concept is so important; therefore, we construct the neuron system with their concept. The neuron system makes the shunting function; thus, the model may have a function for directional selectivity. We initialized the connections and the dendrites by random data, and trained them by the back-propagation algorithm for three-dimensional movement. We made sure the detection of three-dimensional movement in the system.

keywords : *MST area, synapse, dendritic, three-dimensional exercises, nonlinear interaction*

1. Introduction

The visual function is very important. For example, when a visual information and an auditory information differ, a visual information takes priority. A visual function of monkey also growth well not only person. In brain cortex of monkey, it is reported that approximately 55 % is occupied in the visual area[1]. Thus, research of the visual function is frequently done. The visual area exists in six areas, and it is composed of visual area 1~5, Medical superior temporal (MST) area[1]. In MST area, it is guessed that MST area performs exercise of stereopsis. In monkey's MST area, it is known that existence of neurons responding with large planar motion and optical-flows of radiation or rotation around a point[2, 3]. Gibson proposed conception of the optical-flow[4]. It means that points of external moves retia by object moves and flows occurs. He believed that animals perceived three-dimensional motion to be the optical-flow. Thus, Monkey perceived directional selectivity in the visual area of brain. But, C.Koch, T.Poggio and V.Torre regard that cat perceived directional selectivity in the retina[5].

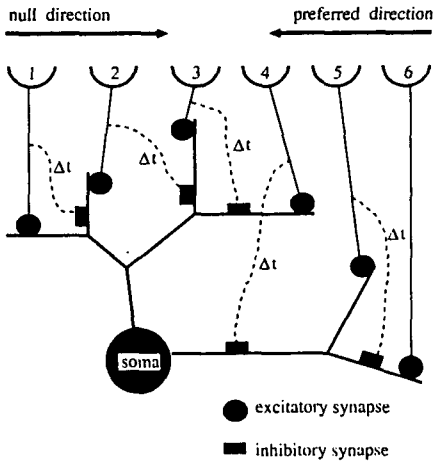

Figure 1: Mechanism of directonal selectivity.

They found directionally selective cells in the retina of cat. They suggested that retinal ganglion cell in cat might have 4 types. Their analysis also showed that γ and δ cells may have strong interactions between excitation and inhibition of the shunting type, and that δ cell's morphology is almost ideal for the mechanism of directional selectivity[5].

Thus, We considered whether inhibition of the shunting type is performed in MST area by C.Kochs' conception. Furthermore, We considered whether MST area is perceived three-dimentional movement by the shunting function. In this paper, We made the shunting function apply to our neuron model. Then, We studied whether a neuron model is perceived depth movement in space. The neuron model after learning to the function for directional selectivity can perceive depth movement. The neuron model after learning is similar to the real neuron's morphology. Therefore, it is considered that the neuron model may be nearer to real neuron and give a good picture for the MST area.

2. Koch, Poggio and Torre model

C.Koch, T.Poggio and V.Torre found directionally selective cells in the retinae of cat. Figure 1 is a model of movement detection with guessed δ cells. This schemes for directional selectivity to motion is based on post-synaptic inhibition of the shunting type on a ganglion cell. Excitation and inhibition from the photoreceptors