Artificial Neuron-Glia Network Based on Multilayer Perceptron

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Abstract

An astrocyte is one of glial cells. The astrocyte was known to the support cell for neurons. However, some some researchers found new important and interesting functions [1]-[3]. Especially, the astrocyte can be information processing different way with the neuron. The astrocyte transmits the signal to neurons and other glial cells by using calcium [4]-[6]. Moreover, the calcium induces the D-serin by this calcium. The D-serin is necessarily to a synapse plasticity [7]. The astrocyte has considered that it is closely related to the human memory. We have focused on the functions of the astrocyte and proposed applications for an artificial neural network.

In this study, we present an artificial neuron-glia network which is based on a multilayer perceptron (MLP). The example of the artificial neuron-glia network is shown as Fig. 1. The MLP is an popular feed forward neural network. The neurons are connected with other neurons in different layers, and the weight of connection of the neurons are updated by backpropagation algorithm (BP) [8]. The BP is uses the steepest decent method; thus, it often occurs vanishing gradient. When vanishing gradient occurs, the network cannot update the weight of connection. We need acceleration methods for of MLP learning. We connect the glia which is based on biological function of the astrocyte with the neurons in the hidden layer. The glia has several functions and affects the connecting neurons such as giving noise and controlling learning. By using several types of artificial neuron-glia networks, we show that the glial function improves the network performance and discuss the glial influence.
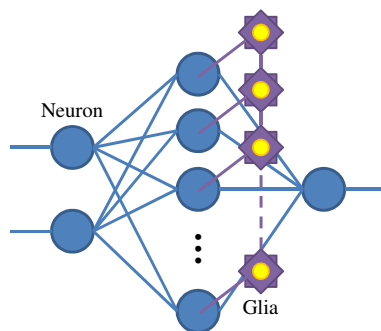
Fig. 1. Artificial neuron-glia network based on MLP.

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