1-17

Copy Weight Parameters for Back Propagation

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1. Introduction

The human brain is classified into the cerebrum, cerebellum, and brain stem. The brain is able to process the vast amounts of information, because the neurons make the huge and the complex network. The cerebellum have the function of the copy thinking of the cerebrum. We focus attention on the function of the cerebrum and the cerebellum.

In this study, we apply such function to the Back Propagation (BP) of artificial neural network. We consider the hidden layer with two groups. The connection weight parameter of the neurons in the one group are copied into the neurons in the other group.

2. Copy thinking of the cerebrum

We consider feed-forward neural network with three layers and the hidden layer is assorted to two groups. We assume that the one group is the cerebrum group and the other group is the cerebellum group. First, the neurons learn by the cerebrum group in the hidden layer and update the connection weight. Second, the connection weight parameter of the neurons in the cerebrum group are copied into the cerebellum group. Finally, the neurons learn by the cerebellum group in the hidden layer and update the connection weight. The proposed network is shown in Fig. 1.

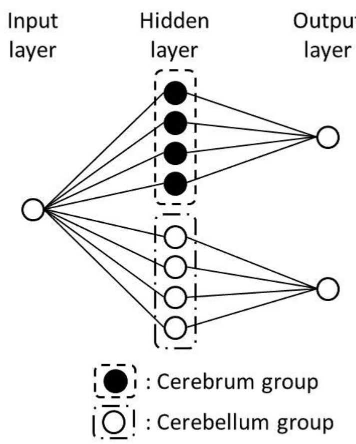

Figure 1: Composition of the proposed network.

The output function is described by Eq. (1). Moreover, the internal state and sigmoid function are described by Eqs. (2) and (3).

$$x_i(t+1) = f\left(u_i(t+1)\right), \quad (1)$$

$$u_i(t+1) = \sum_j w_{ij} x_j(t), \quad (2)$$

$$f(a) = \frac{1}{1+e^{-a}}, \quad (3)$$

where x is the input or output, u is the internal state and w is the connection weight. The square error used for error evaluation is described by Eq. (4).

$$E = \frac{1}{2}\sum_{i=1}^{n}(t_i - O_i)^2, \quad (4)$$

where E is the error, n is the number of output, t is the target value and O is the output value.

3. Simulation Result

In this study, we consider that the number of neurons in the hidden layer is 12. The number of neurons in the cerebrum group are set to 4. The number of neurons in the cerebellum group are set to 8. The learning time is 20000. At the 4000 learning time, the connection weight parameter of the neurons in the cerebrum group are copied into the neurons in the cerebellum group. Finally, the neurons in the hidden layer learn by the neurons of the cerebellum group.

We apply the function approximation to the proposed network. We consider the two-dimensional of Chebyshev polynomial. We compare the proposed network with the conventional network. Figure 2 shows the learning curves of the conventional network and the proposed network.

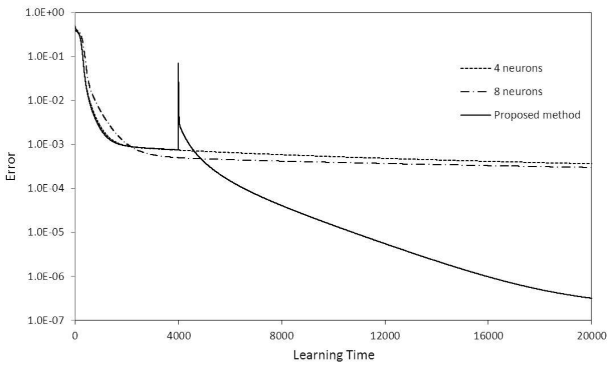

Figure 2: Simulation result.

From Fig. 2, we can see that the error of the conventional network is the worst. The learning performance of the proposed network is better than the conventional network. Because we consider that the connection weight parameter of the neurons in the cerebrum group are copied into the neurons in the cerebellum group.

4. Conclusions

In this study, we proposed the connection weight parameter of the neurons in the cerebrum group copied into the neuron in the cerebellum group. First, the neurons learned by the cerebrum group in the hidden layer. Next, the neurons learned by the cerebellum group in the hidden layer. The learning performance of the proposed network is better than the conventional network.