DOI 10.5281/zenodo.8402510

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DEVELOPMENT OF A NEURAL NETWORK MODEL OF THE CLASSIFICATION PROCESS

Abstract: One of the main issues is choosing the network structure, which is an important factor affecting the efficiency of the network, in studying the characteristics of the process with the help of a network model and developing a control signal based on them. The choice of artificial neural networks (ANN) structure is made depending on the characteristics and complexity of the problem. The selection of the mesh structure was based on the following rules.

Key words: Non-fixed parameters, expert assessment, sigma, activation function, monotonically, current value, parameter value, number of neurons, number of grid layers, number of connections.

The construction of the neural network model of the process was performed using the Neural Networks Toolbox package in the Matlab environment. This package has all the features and tools for designing, modeling and learning ANN. Building a neural network model of the process consists of the following steps:

1. In this case, the minimum number of input and output parameters of the object is selected, and there should be no drift in the parameters of the object's state.

2. All parameters are taken in non-fixed parts. Indeterminate parameters are formed in the form of $\mu(x)$, the relevance function of which can take arbitrary values between 0 and 1. This set of linguistic concepts forms a term. On the basis of expert evaluation, the number, form and relative position of each non-deterministic parameter are determined.

3. Based on the neural network model, a base of non-strict rules is developed [1,2].

The input data to the ANN must be modified (normalized) according to the range of output values of the activation function. The activation function is monotonically increasing and minus 1 to 1 or from varies in intervals up to 1 and determines the dependence of the signal at the output of the neuron on the absolute sum of the signals at its inputs [3,4].

Depending on the distribution of the data, normalization can be linear or curvilinear (logarithmic or "soft" - softmax). Then the proportions between the quantities are preserved:

$$S_i = \frac{x_i - x_{\min}}{x_{\max} - x_{\min}} \qquad (1)$$

here: x_i – current value; $x_{\min}$ – minimum parameter value; $x_{\max}$ – maximum parameter value.

When working with continuous analog data, it is desirable to use a "sigma"-like distribution as an activation function. It is expressed as follows:

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$$f(z)=\frac{1}{1-e^{-z}} \quad (2)$$

The advantage of such an activation function is that it can be differentiated in all areas of the abscissa axis, and it has a very simple property:

$$f^{"}(z)=f(z)(1-f(z)) \quad (3)$$

The data for training the network is prepared in advance, taking into account that the output of the "sigma" function lies in the range from 0 to 1.

One of the main issues is choosing the network structure, which is an important factor affecting the efficiency of the network, in studying the characteristics of the process with the help of a network model and developing a control signal based on them [1-3].

The choice of ANN structure is made depending on the characteristics and complexity of the problem. The selection of the mesh structure was based on the following rules:

1) the possibilities of calculating the grid increase with the growth of the following factors:

- the number of neurons in the network;
- the number of grid layers;
- the number of connections between neurons.

2) the use of feedback leads to the problem of dynamic stability of the network in addition to increasing the computational capabilities of the network;

3) if the algorithm of the network is complicated by using several types of the active function, the calculation capabilities will also increase [3,5].

The optimal balance between mesh accuracy and generalization ability is maintained by the number of hidden elements. The number of such elements, on the one hand, should be sufficient to solve the given problem, but should not be too large to provide the necessary generalizing ability.

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