The Method of Identifying Weights of Artificial Neural Networks with Radial Basis Functions Based on Multiple-Set Approach

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Abstract – **The analysis methods of identification of artificial neural networks (ANN) with radial basis functions. Characterizes the main drawback of the method of identification based on quadratic criteria. The method of identifying weights ANN with RBF based on set-theoretic approach.**

Keywords - **Artificial neural networks, Radial basis functions, Method of identification, Multiple-set approach.**

I. INTRODUCTION

Artificial neural networks have sufficient radial-looking properties, which makes it possible to model the system of profound instability and predict random processes.

ANN with RBF possess universal approximating properties [1], consisting of two layers of information processing and thus, unlike multilayer perceptrons include only linear output layer synaptic weights for the desired performance for nonlinear input-output data.

II. METHOD OF IDENTIFICATION THE ANN WITH RBF BASED ON MULTIPLE-SET APPROACH

Solving the problem of identification of synaptic connections weighting methods based on quadratic criteria, requires large sample survey data of the statistical distribution of noise, which significantly complicates the structure of ANN with RBF and is characterized by high computational complexity.

There is a problem when experimental data are available with certain disabilities and need to solve the problem of identifying weights of ANN with RBF, given the change in noise.

In the general case of RBF ANN with p-inputs and m-outputs is nonlinear transformation type [2]

$$y_j = F_j(x) = w_{j0} + \sum_{i=1}^{N} w_{ij} f_i(x) = w_j^T f(x) \quad f_0(.) = 1 \qquad (1)$$

where y_j - j- th neural network output *(*j = 1,2,…, m*)*, $F_j(x)$- nonlinear transformation of the input vector $x = (x_1, x_2, ..., x_p)^T$ in the *j*-th output, w_{ji} - represents the adjustable synaptic weights, $f_i(x)$ - mean radial-basis function or central function; $w_j = (w_{j0}, w_{j1}, ..., w_{jN})^T$, $f(x) = (1, f_1(x), f_2(x), ..., f_N(x))^T$.

Since the distance x_i calculated using the center c_i and norm- matrix R^{-1}, which are the parameters of hidden layer $x_i = \|x - c_i\| R^{-1}$, then equality (1) can be written as (2)

$$y_j = F_j(x) = w_{j0} + \sum_{i=1}^{N} w_{ij} f_i(\|x - c_i\| R^{-1}) = w_j^T f(\|x - c_i\| R^{-1}) \qquad (2)$$

If the record that $F(x) = \{f_{ij} = f(\|x_i - c_j\|)\}$, then equality (2) takes the form

$$y_j = w_j^T F(x) \qquad (3)$$

In interval form of ANN with RBF can be written:

$$y_j(k) - r(k) \le w_j^{*T} f(\|x - c\| R^{-1}(k)) \le y_j(k) + r(k), \qquad (4)$$

where the parameter $r(k)$ characterizes the noise limits of change $|\zeta(k)| \le r(k)$, and k = 1,2, ... denotes discrete time.

Centers c_i defining the point through which to pass approximated function. Since a large study sample size increases the time in training ANN with RBF widely used clustering pattern.

To find the centers of radial basis functions used algorithm based on the "pit" method of clustering.

The method of identification of synaptic weights of ANN with RBF connections allow for error experimental input data , which take the form of finite intervals.

Using the model structure and interval input data, we obtain the interval system of linear algebraic equations (ISLAE) [4].

Solving ISLAE methods of linear programming, we obtain a set of estimates of unknown parameters - weighs ANN radial type.

III. CONCLUSION

The method of identification weights of synaptic connections of ANN with RBF based methods of analysis of interval data, taking into account the errors of experimental data and does not require large samples of data

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