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USE SELF-ORGANIZING MAP FOR THE SYNTHESIS OF CONTROL SYSTEMS WATER PURIFICATION EQUIPMENT

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Analyzed urgency complement classical architecture control systems Self-organizing map; evaluated prospects of using the default algorithm for self-organization processes modeling of electrical systems, the example of wastewater treatment plants; reasonable limits of process parameters as water purification; synthesized and tested for adequacy relevant Kohonen neural network; received classes (Clusters) parameters as water purification; are promising areas for further research in the supplemented classical architecture control systems Self-organizing map in the case of water treatment facilities management.

Self-organizing map, a neural network in odoochy forgiveness and sewage systems ma control.

During the synthesis of multivariable control objects, the often face a situation where, as a result of changes previously studied technological characteristics created mathematical models lose their adequacy. That control action calculated incorrectly, which may cause failure of node systems [5]. To address this lack of methods proposed to use self-map (CFA) - Self-Organizing Maps (SOM). In these neurons are implemented in nodes dimensional or two-dimensional lattice. P rotses competitive learning based on selective mu nalashtov Anna on different input images (incentives), or classes of input images. The positions of neurons-winners are arranged relative to others. Kohonen model belongs to the class of vector coding algorithms. It provides a topological Vido brazhennya that optimally allocates a fixed number of vectors (code word) in the input space of higher dimension, providing thus stys Nennius data [1-3].

Of the special purpose for which practicing CSR will become electrical installation of sewage treatment. There abrudnyuvachi of such discharges - oil, heavy metals, phenols and nutrients. Overall in 2010 recorded that the water bodies of Ukraine received 460 tons oil, 840 thousand tons of sulphides, chlorides 760 thousand tons, 58 thousand tons of nitrate, causing an extremely negative impact on the environment.

The purpose of research - study and develop methods of applying Self-organizing map analysis for real-time state control objects on the example of water treatment.

Materials and methods research. The algorithm is self consists of the following steps [2]:

1) and nitsializatsiya synaptic weight coefficients in the network (annyam Use of random numbers)

2) for onkurentsiya (competition): T o any input image in all neurons and network value is calculated discriminant function, which is the basis of competition; Mr. eyron with maximum dyskrymi nantnoyi function is the winner;

3) Cooperation: Mr. eyron winning determines the spatial location info neighboring tion of excited neurons;

4) Hey Mr. alashtuvannya in coefficients (adaptation), and on-identification dyskrym nantnoyi functions of excited neurons is increased for a given image by adjusting the weights. In the adaptation response of the neuron-winner at close input image increases.

Adaptation is to change the weight factor depending on the input vector . It is based on the postulate of Hebbian learning: Mr ravylni links amplified and false weaken.

However, in the case of self-pr avylo is inapplicable because no known target output. If connections are modified only towards strengthening, then soon they all reached saturation.

Modification Hebb rule is forgetting to use: $g(y_j)\omega_j$ (ω_j- Synaptic neuron weights j , $g(y_j)$ - Positive scalar function of output y_j .

The only requirement for the $g(y_j)$ - That the error term in its expansion in Taylor's formula was equal to zero, ie

$$g(y_j)|_{y_j=0}=0 \quad . \qquad (1)$$

Modification of weighting coefficients calculated by the formula:

$$\Delta w_j = \eta y_j x - g(y_j) w_j \quad , \qquad (2)$$

where: η - Rate of speed training.

For the condition (1), we choose a linear function $g(y_j)=\eta y_j$.

Equation (2) will look like:

$$\Delta w_j = \eta * y_j (x - w_j) = \eta * h_{ji(x)} (x - w_j) \ . \quad (3)$$

Hence the transition from the point in time n to $n+1$ obtain

$$\omega_j (n+1) = \omega_j (n) + \eta(n) h_{j,i(x)} (n)(x - \omega_j (n)), \quad j = \overline{1, l} \quad . (4)$$

Thus modified weights of all neurons vicinity of neuron-winner i . The value of the weight vector w_i neuron-winner approaching i . Vectors synaptic weight coefficients monitor the distribution of input vectors according to the choice of the neighborhood, thus providing a topological ordering of cards features in the input space.

In what is known for building intelligent block-based neural networks necessary sets of experimental data [3]. However, in many cases, including the established control systems of wastewater treatment plants, with avdannya complicated (impossible) that energy modes electrical installations using different methods to influence the aqueous solutions that meet real objects, experimental set virtually impossible - the high cost and quality requirements for staging equipment and experiments.

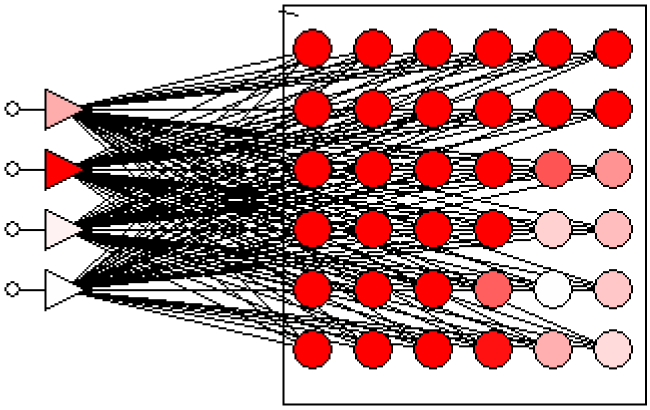
For example, assume that the industrial wastewater facility does not meet the regulatory requirements of the following indicators (the case in many enterprises MIC), biological oxygen demand (BOD), pH, concentration of suspended parts of k and nitrates. Typically, to bring the discharge to the maximum permissible concentration (MPC) can be applied, biological treatment, electrocoagulation, elektrokorektsiyu pH, separation of product in coagulation and flotation (Fig. 1) [4].

Each of the following water treatment unit is based on the use electrotechnologies, with their separate application to provide proof of regulatory requirements, only one (range) indicators of quality. That is, there is a need to collaborate such elements so they form one electrical complex.

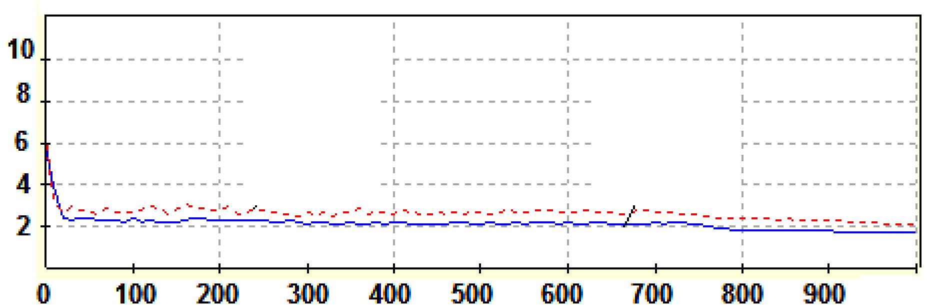
Taking the results of experimental studies of individual modules combined installed water treatment [5] (Table. 1), the package of applied mathematics program "Statistica" synthesized and appropriately configured (mean square error - 2.05%) corresponding Kohonen neural network (Fig. 1). H avchal na sample contained 680 sets carried checking for "re-education".

Table 1 - Experimental study of water purification

Parameter studies	**BOD g / m ³**	**pH**	**The concentration of suspended particles, g / m ³**	**The concentration of nitrates, mg / l**
The limits change	350 - 500	5 - 9.5	500 - 1000	45 - 80
Water treatment module	A erotenk	E lektrokorektor	E lektrokohulyator	F iltr



a)



b)

Fig. 1. Structural and functional parameters Kohonen network: and - the network architecture, - a learning network

With the use of self-expression algorithm (1 - 9), a 4 distinct class and (see. Table. 1).

These results confirm the feasibility of the synthesis of control systems Kohonen network, which is a key advantage over analog is functioning in real time at the possibility of creating a mathematical model of classification with multiple input variables "without a teacher."

Table 2. - Average grade quality parameters of wastewater treatment obtained by applying Kohonen network

The classes	**BOD g / m ³**	**pH**	**The concentration of suspended particles, g / m ³**	**The concentration of nitrates, mg / l**
Class 1	345-349	6,5-6,7	550-561	46-55
Class 2	398-403	6,7-7,1	558-701	73-78
Class 3	430-447	6,9-7,8	865-904	59-64
Class 4	453-481	7-8,3	873-910	52-73

Practical tasks that can solve t ac and neural network and the synthesis and operation of water treatment equipment control systems:

- adaptive formation class quality parameters of wastewater treatment (eg, based on prognostic data);
- adaptive formation of classes of financial costs for the production of energy resources (eg, based on market forecasts).

Conclusions

Self-organizing Kohonen network appropriate and promising to use when creating control information and control systems with special equipment, including the purification of waste water, especially working out their data predictive models, which makes it possible preventive counteract negative factors of natural and man-made.

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