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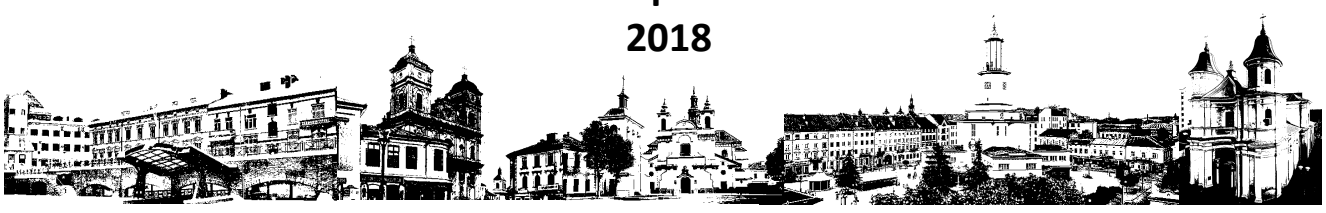
ПРИКЛАДНІ НАУКОВО-ТЕХНІЧНІ ДОСЛІДЖЕННЯ

APPLIED SCIENTIFIC AND TECHNICAL RESEARCH

3 - 5 квітня

"Чим допоміг би нам розум,
коли б ми не могли висловити нашої думки?"
Феофан Прокопович

Івано-Франківськ
2018



УДК 004.032.26

ЗАСТОСУВАННЯ НЕЙРОННИХ МЕРЕЖ ДЛЯ АНАЛІЗУ ЗОБРАЖЕНЬ ГАЗОРОЗРЯДНОГО ВИПРОМІНЮВАННЯ ВОДИ

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APPLICATION OF NEURAL NETWORKS FOR ANALYSIS OF IMAGES OF GAS-DISCHARGE RADIATION OF WATER

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Introduction. The gas-discharge radiation method is used for experimental study of the properties of water and biological fluids [1]. The method makes it possible to study the physical, chemical, biological properties of liquids. One of the problems of using it is the complexity of interpreting the results. One of the key problems of its use is the complexity of interpreting the results. Gas-discharge radiation around a liquid drop is fixed in the form of an image. In this work, the mathematical apparatus of artificial neural networks is used for analyzing image parameters.

Presentation of the material. The aim of the research these studies is the classification of water types. Four types of water with different degrees of mineralization were investigated. The image on the X-ray film is subjected to an analog-to-digital conversion. The radiation image is represented as a matrix. Elements of the matrix of pixels contain geometric and luminance parameters of the radiation. These parameters are associated with the physical, chemical and biological properties of the fluid.

To perform the classification it is necessary to choose the architecture of neural networks. "Classic" neural networks are fully connected. Usually, the algorithm for back propagation of the error is used to train such networks. A full-knit network has a large number of neurons and the algorithm of its training is complex. To eliminate this drawback, Convolutional Neural Networks are used [2].

Convolutional Neural Network consists of several layers. The layers of a neural network have different properties. A convolutional neural network contains: convolutional layers (C-layers), sub-sampling (S-layers). To them at the output are added fully connected layers. Algorithm of a convolutional layer is described as follows:

$$x^l = f(x^{l-1} * k^l + b^l),$$

where x^l – is the output of the layer with the number l;

$f()$ - function of activation of neurons; an asterisk denotes the operation of convolution of the input x with the core k;

b - is the shear coefficient.

The structure of a Convolutional Network assumes that in training for each sample, not the entire radiation image matrix falls on the input, but only part of it. This part is called the core. The core moves along the input image. This method ensures that the Convolutional Network contains a fixed number of neurons in the input and output layers. Accordingly, the number of weight coefficients is set.

The task of learning is to adjust the weighting factors. In the framework of these studies, a Convolutional Neural Network was tested for the classification of images of gas discharge radiation of water with different mineralization. The recognition accuracy was 93%. Accuracy was calculated as part of correctly classified radiation images to the total number of images.

Conclusion. The article deals with the solution of the urgent problem of express classification of water types. This method is not based on the definition of specific physical or chemical parameters. The advantage of this method is the possibility of obtaining integral characteristics of water properties. The proposed approach can be used in environmental monitoring systems.

References.

1. Povstyanyi V.A. Peculiarities of gas-discharge luminescence of biological fluid from the achilles tendon in the late postmortem period / V. A. Povstyanyi, L. A. Pesotskaya, N. V. Glukhova, N. M. Yevdokimenko, L. R. Nikogosyan, Ye. L. Koshelnik. // Journal of Education, Health and Sport. - Licensee Open Journal Systems of Kazimierz Wielki University in Bydgoszcz, Poland. - 2017;7(2), PP. 498-508. eISSN 2391-8306. DOI http://dx.doi.org/10.5281/zenodo.399324.

2. Ciresan D. C. Flexible, high performance convolutional neural networks for image classification. / D. C. Ciresan, U. Meier, J. Masci, L. M. Gambardella, and J. Schmidhuber // In Artificial Intelligence, International Joint Conference, P. 1237–1242, - 2011.