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# NERUAL NETWORK TECHNOLOGY OF THE FINANCIAL MODELSYNTHESIS OF PRODUCTION AS THE AS AN ELEMENT OF REGION'S ECONOMY DIGITALIZATION

*Abstract. There is shown the develop a technology for designing neural network models for automatic monitoring of the tax burden to achieve the optimal balance between the possibility of developing a successful business and sufficient filling of the regional budget. The automation of the process of determining the elements of the gradient vector was produced in implementing traditional method of the back-propagation of error by using neural control technology. For the first time, a solution to optimize the fiscally-tax burden (FTB) of the region has proposed with the application of the back-propagation algorithm. Using the proposed methodology a software tool will be created for the transition to an automatic system for optimal management of the economy.*

*Keywords: digitalization, fiscal and tax burden, neural network, neural network optimization, regional economy.*

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# НЕЙРОМЕРЕЖЕВА ТЕХНОЛОГІЯ СИНЕТЕЗУ ЕКОНОМІЧНОЇ МОДЕЛІ ВИРОБНИЦТВА ЯК ЕЛЕМЕНТ ЦІФРОВІЗАЦІЇ ЕКОНОМІКИ РЕГІОНУ

*Анотація. Представлена розробка технології побудови нейромережевих моделей автоматичного моніторингу стану податкового навантаження для досягнення оптимального балансу між можливістю розвитку успішного бізнесу та достатнім наповненням регіонального бюджету. Проведена автоматизація процесу визначення елементів вектора градієнта при реалізації традиційного методу зворотного поширення помилки за допомогою застосування технології нейроуправління. Вперше запропоновано рішення оптимізації фіскально-податкового навантаженням (ФНН) регіону з застосуванням алгоритму зворотного поширення. Використання запропонованої методики дозволить створити програмний інструментарій для переходу до автоматичної системи оптимального управління економікою.*

*Ключові слова: нейронна мережа, нейромережева оптимізація, фіскально-податкове навантаження, цифровизация, економіка регіону.*

In modern conditions the formation of the digital economy is a complex task of transition to a new technological level due to the introduction of information and telecommunication technologies at all stages of the value added chain. The main task of this process is obvious which is increasing the competitiveness and efficiency of the economy, developing its commodity potential, and improving the quality of consumer satisfaction of citizens. Deep digitalization involves introduction into production and management of new information technologies (nanotechnology, microbiology, artificial intelligence, total computer communications, etc.), which provide solution of the task of automating the control and management of the entire production process [1-3].

The problem is that a modern manufacturing plant belongs to a class of complex systems [1]. The term "complex system" is understood to mean an entity that has input factors and high-dimensional output states with poorly formalized, fuzzy relationships and a high degree of priori uncertainty [2]. The high dimensionality of factors and states, poorly formalized and unclear relationships, the presence of a human factor create a high degree of uncertainty in the production process, which does not allow making optimal decisions on control and management based on current input data. It is this feature that does not allow formalizing production in full and algorithmizing all financial and economic chains from investments to storage and sale of products.

However, full automation, robotization and intellectualization of production isthe imperative of time [1,4,5]. The main prize of market competition is the possibility of extracting intellectual rent, obtained due to technological superiority, protected by intellectual property rights and allowing having additional profit as a result of achieving greater production efficiency or higher product quality. In pursuit of this technological superiority for a manufacturing enterprise, the key task is to synthesize an adequate mathematical model of the enterprise, which will ensure the application of optimal decision rules and allow implementing instrumentally all the complex of control and management procedures in automatic mode [6,7].

This is facilitated by the availability of clear and tested by practice criteria for the quality of production and providing them with informative factors. Then using the modeling technology of complex systems [1,4], the task of modeling the financial and economic activity of the research object can be reduced to solving the problem of nonlinear optimization in the multidimensional space of factors and high-dimensional states [5]. At the same time, it is necessary to highlight the key quality criteria expertly, to put them in line with the values of the supporting factors on historical examples (retrospective data), and to establish and record rigorous analytical links through the forced learning of neural network models in a retrospective sample of practical examples [3].

Thus, the subject expert describes the task at the verbal level in terms of the financial and economic paradigm, and the specialist in information technologies deals with the formalization of the task and its instrumental solution.

As shown in [1, 6], it is expedient to apply intellectual procedures for data analysis on the basis of artificial neural networks for objects of the investigated type.

This choice of analytical tools is conditioned by undeniable and important advantages for practical use:

–neural networks are adaptive learning systems that extract information from real processes by examples, which are difficult to dynamically simulate, and frequently it is impossible, because they often contain a significant array of hidden, uncontrolled, incomplete and noisy parameters and mutual connections between them;

–their use makes it possible to solve problems that are difficult or impossible to solve by using traditional methods due to the absence of formalized mathematical descriptions of the functioning processes;

–they have an associative memory and in the course of the work they accumulate and generalize information, from which their effectiveness increases with time;

–their use is based on training the neural network to extract information from the experimental data, which ensures the objectivity of the results and increases their reliability.

In addition, modern software platforms (Neuroland, Matlab, Statistica, etc.) allow us to design quickly a neural network environment and implement a wide class of architectures of neural networks with various complexity and rules for modifying weights in the process of compulsory training. At the same time, the use of artificial intelligence technology in managing complex objects requires taking into account specific features of each subject area, including a manufacturing enterprise with a specific set of indicators, criteria, factors and relationships between them. This fact reveals the need to adapt a set of standard options (preprocessing, organization of homogeneous subsets, factor analysis, input sensitivity, classification, forecasting, etc.) of the corresponding package of technical analysis to a specific field of study.

**Conclusion**

1. In order to automate the determination of the values of the factors that bring the actual state of the FESO to the target one, it is necessary to find the functional dependence of its states on the values of the factors. This problem has been solved using the technology of neural control and realized by models of multilayer perceptrons as the inverse problem of recognition.

2. The calculation of partial derivatives with respect to the input factors of the output function of the residual of the current and required states of the NNF and the generalized gradient estimation are based on the known properties of neural network circuits functioning in the "emulator-controller" bundle. This allowed us to automate the process of determining the gradient elements when implementing the traditional method of back propagation of the error.

3. Practical significance of the research results is the creation of software tools for transition to automatic systems for adapting the space of input attributes to the space of required classes in the management of the financial and economic state of the enterprise.

4. The developed technology, methodical, algorithmic and software tools allow automating the processes of classification of FESO states, adaptation of input factors to the target state of the object.

5. Modeling and interpretation of results on the platform of neuromuscles is an effective tool for automating decision-making in real-time management for the enterprise economy.

6. Functionally, the program of trained models can be implemented as a program unit for analyzing data and making decisions in the format of two basic subsystems for classifying the states of the object of research and adapting input factors to target states that interact with

Automation of basic FESO processes, performed on the basis of practical implementation of artificial intelligence capabilities in the neural network format, allows increasing the enterprise's competitiveness and reduces production costs.

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