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«A combined method for designing operations using soft computing»

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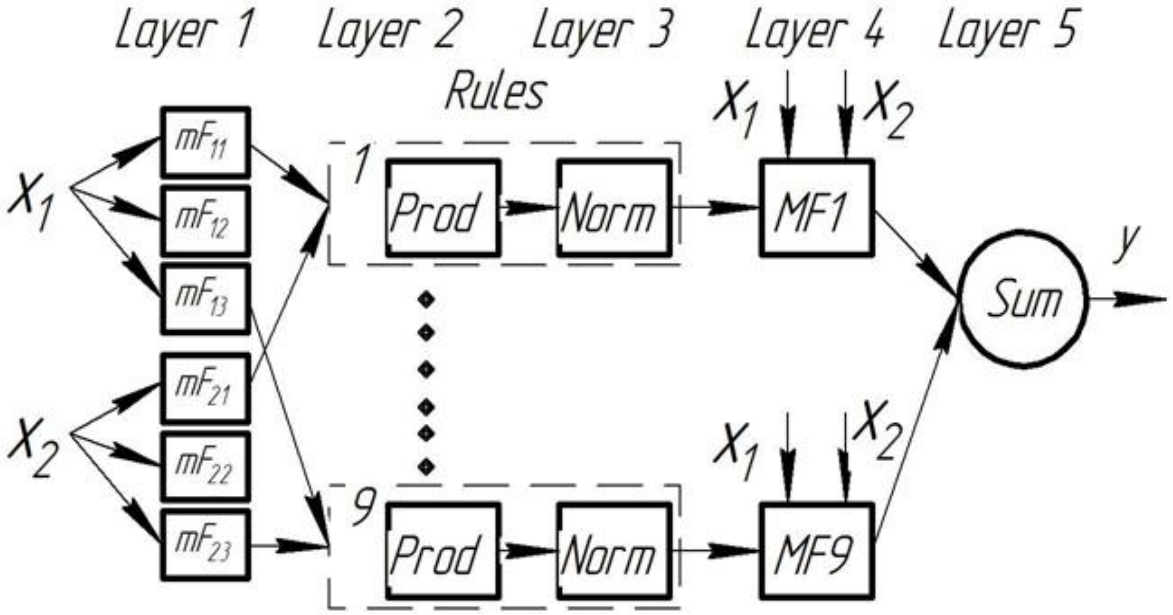
Problem statement

- For modern production, characterized by great flexibility due to constant upgrades and changes in manufactured products, small series, short production times, the task of reliable and quick design of technological operations is relevant. Moreover, the quality of the proposed technological solutions must meet the highest requirements. For this, it is necessary to widely apply multicriteria optimization methods, to take into account the complex interrelations of operational, structural and technological parameters. Moreover, less time is being devoted to working out and identifying all of these relationships and the complexity of design and research work is growing.

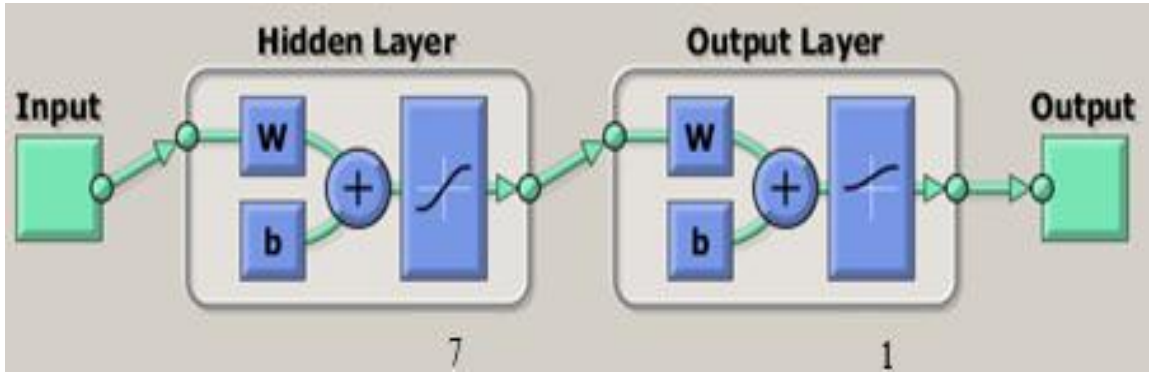
Solution methods

- To work with the necessary dependencies, it is proposed to use two different modeling methods. The first is a soft computing, including neural fuzzy networks, the second is a neural multilayer network.
- To approximate nonlinear dependencies, the ANFIS hybrid network is used for fuzzy inference by the Sugeno method



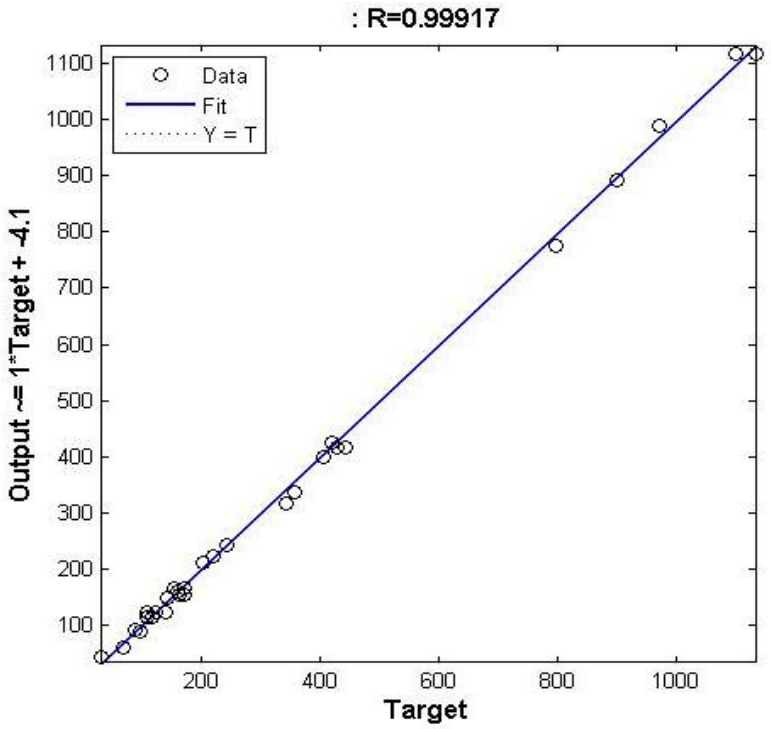
Solution methods

- The neural network selected for use is the feed-forward neural network. It has two layers. The input vector includes two parameters (the angle of bending of the pile and the diameter of the pile), the output is the magnitude of the stresses. In the first layer, the number of neurons varied from 5 to 15. The best learning result was obtained with 7 neurons with a sigmoid activation function. The output is one neuron with a linear activation function.

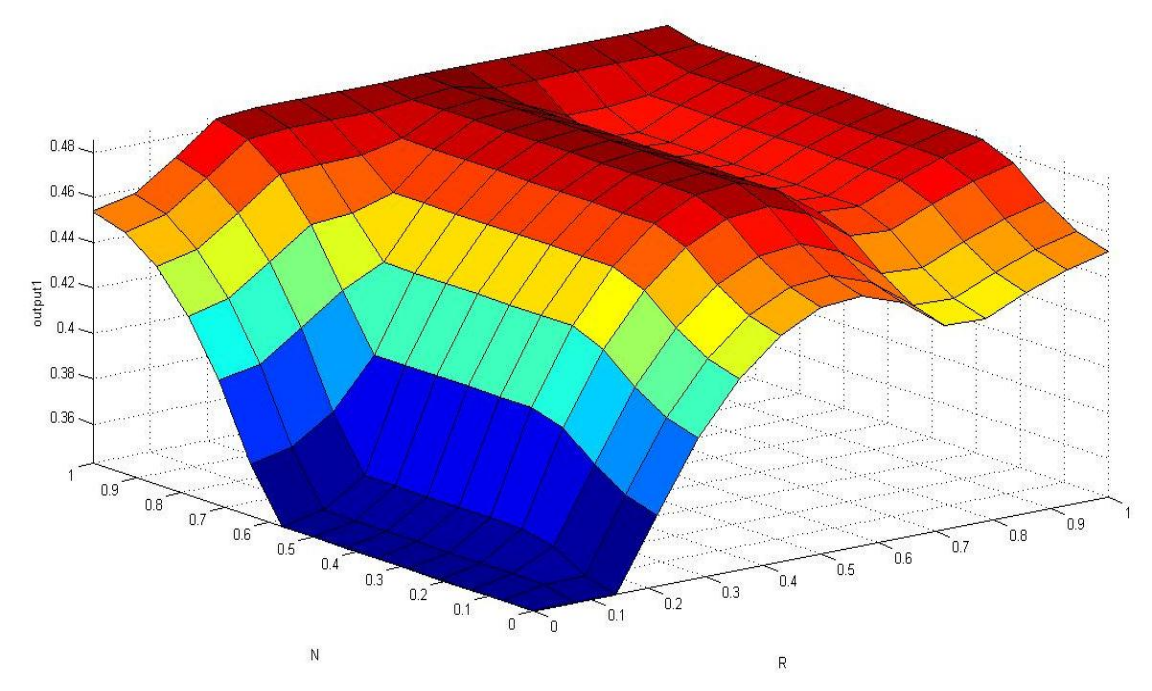


Solution methods

- The fuzzy system was trained according to the dependences obtained in the course of analytical calculations, supplemented by the results of CAE-modeling. Then the selected neural network was trained. Plot regression is shown in figure.



Results



- For example, figure shows the output surfaces for the dependences of the cladding power on a set of parameters (embedment radius, interference fit, pile diameter, pile overhang). Dataset was formed on the basis of information from individual dependencies. To reduce the error, the initial conclusions obtained and the settings for the membership functions of the output system are set according to control points

Conclusions

- The use of modern modeling methods significantly expands the possibilities for the design of technological operations. The joint use of neural networks, fuzzy inference systems, analytical and experimental research methods allows for a variety of preparatory work in the design of operations. Moreover, for a variety of production conditions, it is possible to quickly adapt existing models to specify technological modes and perform their optimization. Moreover, the choice is not limited only to the purpose of the technological regime, but also allows you to determine a variety of other related design and technological conditions, as can be seen from the example considered when applying the cladding method.

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