The use of mathematical models to improve the effective functioning of enterprises

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Abstract. In the process of ensuring the innovative development of machine-building enterprises within the framework of the concept, it is necessary to use mathematical models that correspond to machine vision technologies, robotic technology, automated and intelligent production and control systems at enterprises. Mathematical models of robotic technology allow us to create new equipment, improve technological processes and production organization systems.

Various enterprises must be reliable in terms of production safety and the effectiveness of their functioning. It is necessary to strictly comply with the technological process of production, control and prevention of emergency situations, stable operation of the equipment. The effectiveness of the enterprise involves the stability of the enterprise and minimizing risks. All this implies a mandatory preventive repair plan, which allows you to follow the progress of repair works, both scheduled and extraordinary, as well as to ensure the priority of those that are directly related to product safety. In addition, the company needs control of incoming and outgoing flows of raw materials, identification of risks associated with the production of a particular product, the likelihood of this risk occurring, and so on.

All of this can be achieved experimentally, but it will require a long time and serious costs [1]. Time and costs can be significantly reduced if mathematical modeling techniques are used to increase the efficiency of production functioning.

Depending on the type of problem being solved, various topologies (structures) and types of neural networks are used. Machine vision technologies based on neural networks are widely used for diagnostics and quality control in industry, in particular in mechanical engineering, and have a lot of advantages over such classic models as gradient, statistical, local adaptation, template, etc. The key advantages of neural networks over other mathematical models are self-learning, fault tolerance and speed of work.

Used in conjunction with robots, machine vision systems can significantly expand the range of tasks in production [8]. Among the tasks of the "vision + robot" system we can distinguish the movement of products, loading/unloading, classification of objects, rejection of products, inspection of objects from all angles.

The advantages of using of machine vision for robots are: robot control during production, accuracy of work, comprehensive control of products, eliminating of need to buy high-precision equipment, preventing accidental collisions of robots, the ability to process various objects without complex reconfiguration, etc.
Machine (technical) vision systems allow you to automate the management of production processes by analyzing visual information and controlling products. Industrial video cameras are used to create images. The software of machine vision systems analyzes what they see and passes this information to the operator, automated control system, robot or actuators to control the production process. The special effect of machine vision systems is manifested when the complexity, volume or speed of the analyzed information significantly exceed the abilities of the operator.

In the process of developing and implementing such systems, stochastic geometry methods, neural network technologies, regular grid interpolation models, etc. are widely used [5].

To solve various problems in mechanical engineering, robots, mechatronic and robotic systems are more often used. This is due to their growing functionality, due to the use of more advanced control systems, the development of which is based on the well-known achievements of computer technology [9].

At machine-building enterprises, automated systems for the production and assembly of parts and machines, automated process control systems, which, as they develop, take the form of intellectual production systems, are widespread now [2].

The mathematical model is the basis for the functioning of these elements, and modeling is carried out using computer technology, since it requires a significant amount of computation [5].

The wide range of mathematical models is used to model intelligent manufacturing systems [3].

To solve the problems of quality control, tracking the movement of products, monitoring the availability of objects, measuring their geometric dimensions, comparing with a sample, counting, identifying and classifying objects, rejecting products, inspecting objects from different angles, and highly accurate measurements of elements (for example, blanks or individual parts) etc. in automated systems in production, stochastic geometry models, interpolation models on regular lattices, cluster analysis methods, and artificial neural network models can be used [7].

The results of such innovations can be an improvement of working conditions, an increase in product quality, a reducing the need for labor force and a systematic increase in the profits of engineering enterprises [6].

The most promising models for implementation at engineering enterprises are models of artificial neural networks, which is associated with a wide range of possible tasks, which includes modeling of machine vision, mechatronic and robotic systems, production automation tasks, and intelligent production systems.

It should be noted that the widespread dissemination of high technology has opened access to vast amounts of information. The data stream is constantly growing. But the more information is collected, the more difficult it is to see in it trends and patterns hidden from a superficial view. It is important in these conditions to be able to quickly and timely find useful information and effectively use it. Improving competitiveness is almost impossible to achieve randomly. Therefore, a set of methods and techniques is needed that form an innovative competitiveness management system. The application of methods of economic and mathematical modeling has expanded thanks to modern PC software [4].

Attracting innovative mathematical methods and models is especially important for improving the scheduling of production processes, for example, with the project method of organization of production. This task is associated with the allocation of limited resources for project operations. Often the task of optimal allocation of resources in a project (set of operations) is called the task of scheduling. Note that such a task refers to complex multi-extreme or combinatorial optimization tasks.

Features of mathematical models of industrial production depend on the features of the structure, composition and functioning of the enterprise systems.
Currently developed models and methods for description and analysis of the main processes at engineering enterprises cover various engineering, economic and software aspects.

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