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SECTION 13.
AUTOMATION AND APPLIANCES MAKING

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ANALYSIS OF METHODS OF CONTROL OF CNC MACHINES IN CYBER-PHYSICAL PRODUCTION SYSTEMS

Computer Numeric Control (CNC) machines are controlled using one of the following methods: - direct communication and feedback methods; - methods of additive, intelligent and robust control systems. With the help of the direct communication method there is a flow of directive information, which is sent from the control unit to the control object. Control with direct communication allows to carry out management with exact supervision of all parameters and conditions (fig. 1).

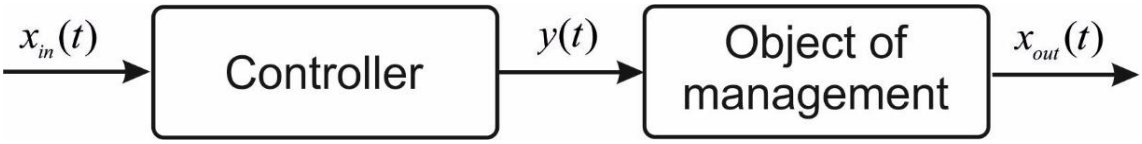

Fig. 1. **Direct communication CNC machine tool control system**

This control principle is implemented only on the basis of the desired algorithm of behavior of the controlled object and does not include the possibility of external influences that can cause uncontrolled deviations in the operation of the object. The control system with feedback allows to provide control of initial size (fig. 2) The control system with feedback allows to provide control of initial value (fig. 2). In this case, the control device creates an effect on the control object depending on the deviation of the input value from the specified.

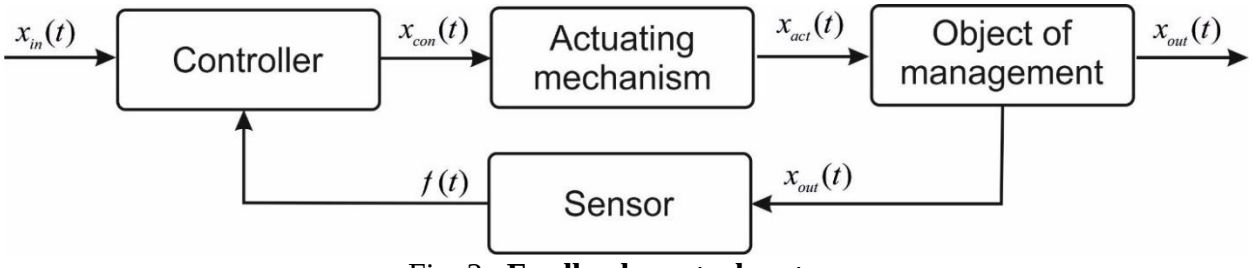

Fig. 2. **Feedback control system**

The principle of feedback allows you to measure the adjustable parameter and use the information obtained in the formation of control laws. Control systems closed by an adjustable parameter have better characteristics in comparison with systems with direct communication, as deviations are estimated and on their basis correction of influence can be carried out, increasing coincidence of current and necessary behavior of object. [1]. Robust control - a set of control methods, the purpose of which is the synthesis of a regulator that would provide good control quality, if the control object differs from the calculated or its mathematical model is unknown. Thus, robustness means a small change in the output of a closed control system when changing the parameters of the control object. Typically, robust controllers are used to control objects with an unknown or incomplete mathematical model, and containing uncertainties [2-3].

The structural model of robust control is presented in Figure 3. The purpose of the synthesis of robust system is to guarantee the required quality regardless of errors and changes in model parameters. Robust control system has the required quality despite the significant uncertainty of the characteristics of the control object. The system must be able to counteract the influence of these factors in performing the tasks for which it was designed. The structure of the regulator is chosen so that the response of the system meets certain quality criteria [4].

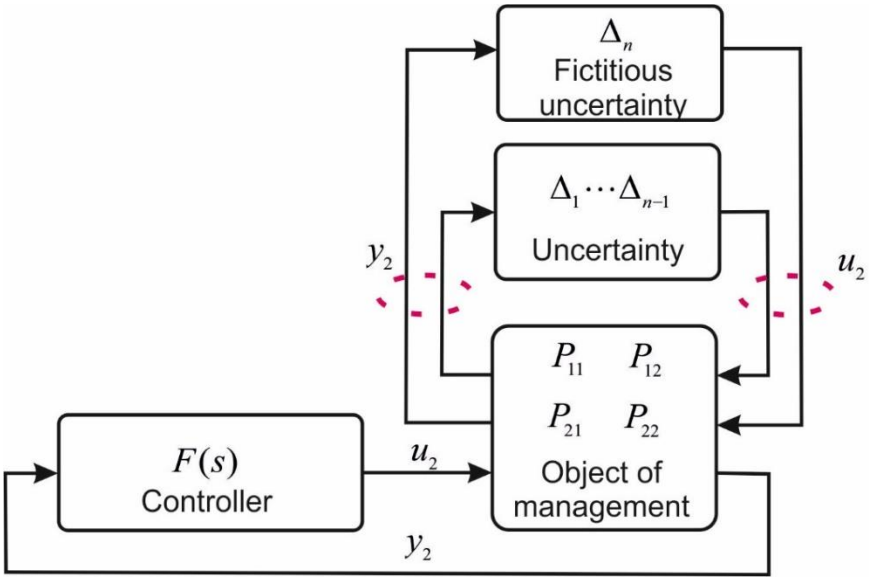

Fig. 3. **Structural model of robust control**

Intelligent automated control system (Fig. 4) is able to some extent to reproduce certain intellectual human actions associated with the acquisition, analysis, classification of knowledge in the subject area of management, as well as operating knowledge accumulated by the operator or the system itself during practical activities for facility management.

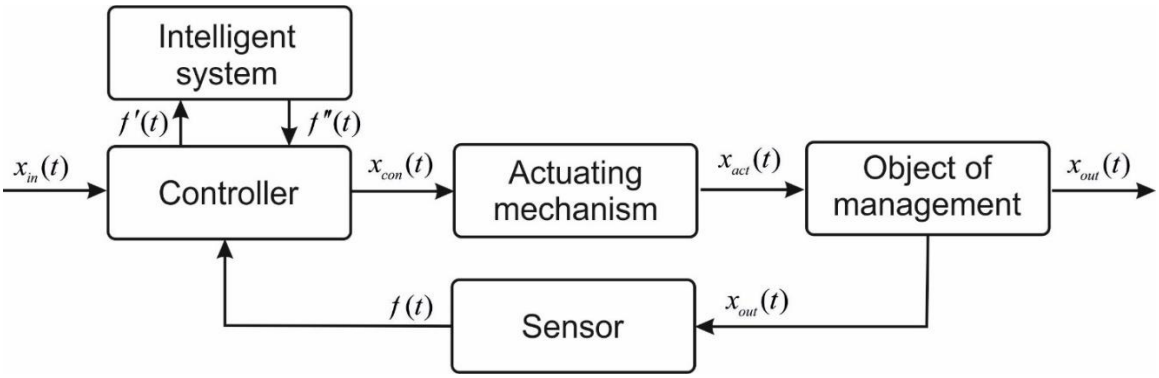

Fig. 4. **Structural model of intelligent control system**

The intelligence of the system is characterized by the ability of the system to work with the database of events in order to identify knowledge that can clarify the task and identify ways to solve it. These intelligent automated control systems are used in complex cyber-physical production systems, at the level of intelligent sensors and Programmable Logic Controllers. (PLC) [5].

Conclusions. It is determined that the best option for the machine control system with CNC in the creation of cyber-physical production systems for Smart Manufacturing - are intelligent control systems that allow you to reflect physical processes in digital prostrate in real time, which is a key requirement in Ops 4.0 concepts.

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