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Adjuster Synthesizing for the Heat Process with Matlab

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Annotation: This article examines the process that takes place in adjusters for the heating process. The synthesis of the adjuster for the heating process using the Matlab program was analyzed in model mode. In the course of the study, characteristic values were obtained based on the transmission functions in the system. The results were obtained through a block diagram to optimize the adjustment parameters of the adjuster.

Keywords: Nonlinear Control Design Blockset, toolboxes, PID adjuster, Simulink nonlinear model, system transients.

Address of the President of Uzbekistan Shavkat Mirziyoyev to the Oliy Majlis on 25.01.2020 It is necessary to form an electronic platform for scientific achievements, a database of local and foreign scientific developments. Every higher education and research institution must cooperate with prestigious foreign universities and research centers.

It is intended to be a turning point in the development of the digital economy. Construction, energy, agriculture and water management, transport, geology, cadastre, health, education, archives need to be fully digitized. The e-government system will be critically reviewed. IT-parks on the example of the capital will also be organized in Nukus, Bukhara, Namangan, Samarkand, Gulistan and Urgench. The development of the Digital Uzbekistan 2030 program will be completed in the coming days. Government and parliamentary oversight will be strengthened.

Based on the name of the year and the President's address, this article aims to calculate the problems of thermal power plants on the basis of digital technologies using the modern program MATLAB.

MATLAB is a high-performance computing language. It can be used in mathematical calculations, modeling algorithms, data analysis, research and visualization, scientific and engineering graphics, application design, and more. Solving specific problems using MATLAB is done several times faster than in other scalar programming languages (for example, C++). In industry, MATLAB is a highly productive tool for research, development, and data analysis. Special groups of programs called toolboxes in the MATLAB system are of great importance. They allow most users to learn and apply specific techniques in research and design. Toolboxes are a detailed collection of MATLAB functions that can be used to solve specific problems.

To adjust the heating process, it is necessary to select an adjuster that achieves equilibrium mode in a short time.

If the object is nonlinear and its transmission coefficient varies within the normal operating mode, then the calculations take into account the maximum value of the k_{ob} transmission coefficient.

In addition, the following should be taken into account when choosing an adjuster:

1. The maximum possible value of excitation under load u_6, which represents the percentage of motion of the saturated, jumping and continuous monotonous adjustment body, the maximum speed of excitation in continuous monotone excitation is set to Au_v. must be.

2. Necessary quality indicators of adjustment:

- Maximum allowable dynamic deviation x_1
- Permissible (or desired) over-adjustment - as a percentage of x_2, x_1;
- Permissible residual deviation - δ
- Permissible limit adjustment time - t_p, sec.

Using the above data, it is necessary to calculate the required dynamic adjustment coefficient R_d. As a result, it is possible to determine the required value of x% dynamic deviation:

$$R_d = \frac{x_1}{k_{ob} \cdot y_v}$$

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Using the graph of R_d, we select an analog PID adjuster for the adjustment of the required character (this is determined from the required value of the override). t/T provides a dynamic adjustment coefficient at a given value.

Based on the above information, we build a block diagram of the process:

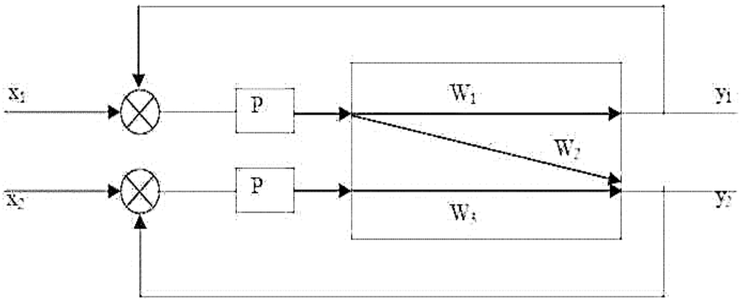

Figure 1. Structural scheme of the control system.

The transmission functions in the system are as follows:

$W_1(\text{p}) = \frac{4.5}{\text{p}(14\text{p}+1)}$;

$W_2(\text{p}) = \frac{1.8 \cdot (21.2 \cdot p+1)}{20.8 \cdot p^2+43.4 \cdot p+1}$;

$W_3(\text{p}) = \frac{4.22 \cdot (0.85 \cdot p+1)}{20.8 \cdot p^2+43.4 \cdot p+1}$;

The problem is that you need to choose a control signal generator that keeps the set values of the temperature. We will solve this problem using the Matlab program. We formulate the block diagram of the above control system in the Matlab program without an adjuster and construct the transient process of the system (Figures 2 and 3).

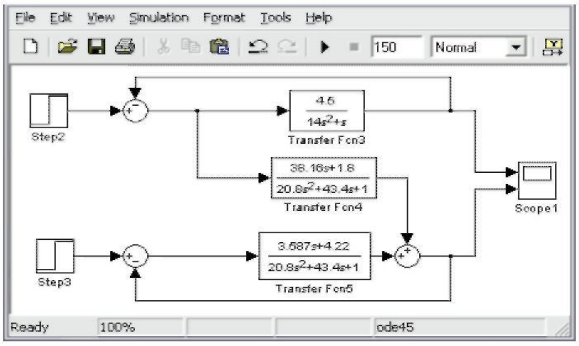

Figure 2. A model of the process built into the Matlab program

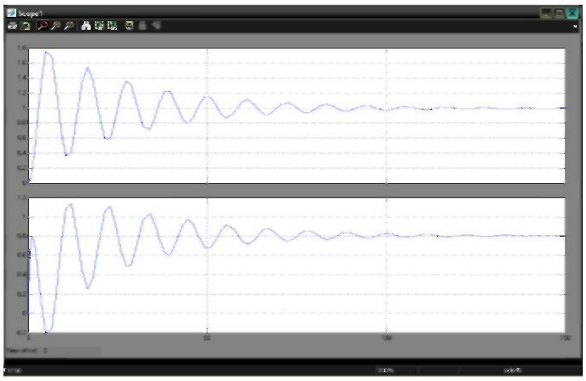

Figure 3. Transient process characteristics of a technological process

Now let's build a process model together with the adjuster and create a transient process characteristic.

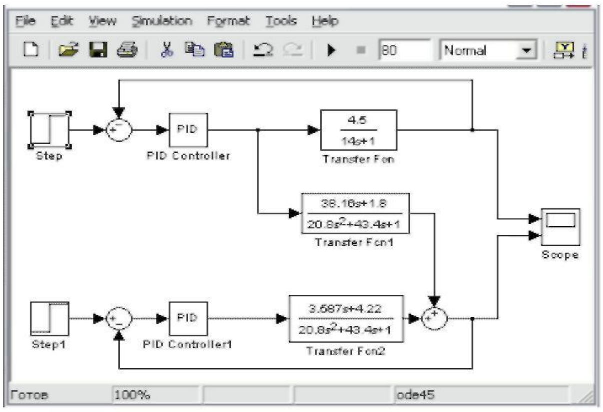

Figure 4. A model of the process built into the Matlab program along with the adjuster

Figure 5. Transient process characteristics (with adjuster)

Optimizing the settings of the adjuster

The technological process under consideration has two controllable and controllable parameters. This situation poses a number of difficulties in solving object analysis and synthesis problems.

From the above transient processes, it can be seen that the oscillations in the process are large. This indicates that the quality of the system is poor. To improve the quality of the system, it is necessary to determine the optimal values of the adjustment parameters of the regulator.

We do this using the Nonlinear Control Design Blockset (NCD-Blockset) toolkit that is part of the Matlab program.

This toolkit has a simple and user-friendly interface, making it very easy for the user to adjust the dynamic parameters of the object, providing the necessary quality indicators of the transient process.

An approach through optimization that minimizes function is adopted as a means to an end. With this toolkit, you can adjust the parameters of the Simulink nonlinear model, including any number of variables, scalars, vectors, and matrices. It is also possible to take into account the parametric uncertainties of the mathematical model, which allows to synthesize the laws of control in the tuning process.

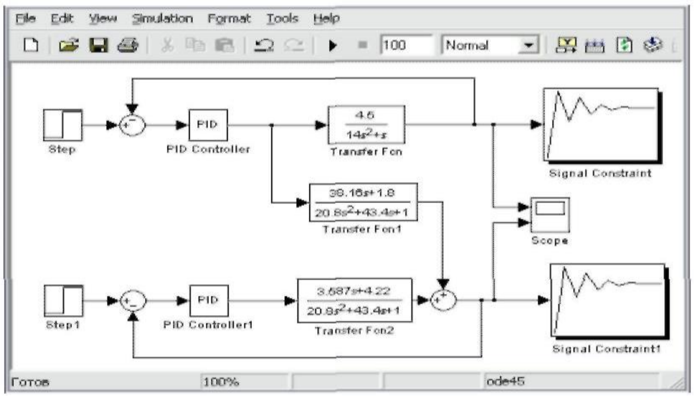

Figure 6. Block diagram of the object in conjunction with the adjuster.

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Suppose you want to control an object using the feedback principle. We form a block diagram in the MatLab program using the controller adjuster (Figure 6).

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