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DEVELOPMENT OF ALGORITHMS AND PROGRAMS FOR MULTI-CIRCUIT DIGITAL REGULATION OF AUTOMATED PROCESS CONTROL SYSTEMS

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Annotation
This paper considers the problem of automation of technological process control systems. Algorithm and programs of multiloop digital regulation of automated process control systems are developed. Three types of multiloop control systems are considered: combined, cascade and multiloop connected control systems. The results of the work can be used in the development of industrial systems of digital regulation.

Keywords: automation, control system, digital, multiloop, single-loop modeling, recurrence form.

Introduction

Automation of production is one of the most important directions of scientific and technological progress, the development of which has an objective character. This is due, first of all, to the fact that due to automation the tasks of increasing the productivity of production and improving working conditions are solved. Automated control systems of technological process provide a stable course and do not allow its important indicators to deviate from the

normal values. However, the main component of the technical effect of implementing a full-scale automated process control system should be primarily related to improving the quality of automatic control of technological equipment [2].

The effectiveness of full-scale automated process control systems significantly depends on the quality of implementation of the most important of the automatic control functions. One of the ways to improve the quality of automatic control is to improve the procedures for parametric synthesis of the automatic control system [5].

As regulators in the vast majority of control systems in petrochemical, oil refining, power, metallurgy and other industries of the Republic of Uzbekistan and foreign countries are mainly used the so-called typical industrial regulators with proportional, proportional-integral and proportional-integral-differential laws of regulation [4].

A significant part of the currently existing automated process control systems is single-loop, but along with single-loop control systems, multiloop control systems are widespread. They are used to control complex objects. These objects generally have several interrelated regulated quantities, which are controlled by one or more actuators. In automated process control systems it is advisable to replace the set of regulators and compensators by a single control program of the regulator unit. This paper develops algorithms and programs for multi-circuit control.

The paper considers three types of multiloop control systems

control systems: combined, cascade and multi-circuit systems of coupled control. As a combined system, the system of oxygen content regulation in flue gases with compensation of fuel consumption perturbations by air consumption in a given ratio is considered. As an example of a cascade system, the temperature control system in the distillation column cube heated by a steam boilers is considered.

The internal stabilizing loop is the system of water steam flow regulation in the boilers, and the external correcting loop is the system of temperature regulation in the cube. It is shown that by introducing a stabilizing loop, the transition time and dynamic error are reduced by 2-3 times. An example of a coupled control system was a steam boiler control system, in which 2 control loops are provided: control of steam pressure by fuel flow and control of oxygen content in flue gases by air flow. Introduction of dynamic compensators allows to make the regulation process stable.

For modeling and control using a computer, it is necessary to use special digital methods based on the discrete representation of continuous functions and recurrence relationships, which allow calculating the control actions in real time [1]. The peculiarity of the developed algorithms and programs is the recurrent form of functions of regulators and compensators. This provides simplicity and accuracy of calculations in comparison with the algorithms used in some Scada programs. Recurrence relations allow to simplify the calculation of a sequence of values, where each new current value of the function is calculated based on the current and previous values of the arguments and previous values of the function.

Let us take a second-order aperiodic object described by a continuous model as an object model [4].

The transition from the stage of model building to its subsequent use requires an evaluation of the quality of the resulting model, i.e. a check of the adequacy of the model to the object. Due

to the fact that absolute equivalence of a model to an object is in principle unattainable, the main condition for checking model adequacy is the possibility to use the model to solve the problem, for which this model was constructed. Therefore, adequacy implies that the model reproduces all properties of the object with the necessary completeness.

The efficiency of the developed algorithms and programs was tested by mathematical modeling of multiloop control systems. In this case, a discrete model of the object was used as a mathematical model. It was assumed that the input data are the arrays of input and output signal values obtained at discrete moments of time with a certain quantization period [3].

The results of this work can be used in the development of industrial digital multiloop control systems.

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