SYNTHESIS OF THE AUTO-TUNED PID CONTROLLER TO THE INERTIAL OBJECT

Anatolii BALABANOV, Bartolomeu IZVOREANU, Mihail POTLOG, Ion FIODOROV, Irina COJUHARI, Dumitru MORARU

Technical University of Moldova, Bd. Ştefan cel Mare, 168, MD-2004, Chisinău, Republic of Moldova

Corresponding author: **anatolii.balabanov@ati.utm.md**

In the paper, it was developed the mechanism for adaptation of the transfer coefficient of PID controller to the model of object with inertia first order and time delay; schema for simulation of the control system with adaptive controller and the research results of the functioning of the adaptation internal contour of the PID controller, which it realizes the auto-tuning of the controller`s parameters.

For the given model of the control object with the parameters $k_0 = 0{,}42,\ T_0 = 60\ \text{s},\ \tau = 30\ \text{s}$ the parameters $k_p = 6{,}94,\ T_i = 48\ \text{s},\ T_d = 10\ \text{s}$ of the PID algorithm were determined according to the Ziegler-Nichols method as initial parameters for the procedure of adaptation the transfer coefficient k_p of the controller. The parameters of the control object $k_0,\ T_0$ and τ were varied by ± 50% from the initial values.

The obtained results demonstrated that in order to achieve the high performances of the automatic control system it is necessary to perform at least three cycles of adaptation of the k_p tuning parameter. The criterion for stopping the adaptation cycle it can be used to assess the increase of the step variation of the coefficient k_p: $k_p\left|K_p^{i+1} - K_p^i\right| \le \varepsilon$, where *i* is the adaptation step. The value of ε is chosen based on the precision conditions of the system (the recommended value is 0.05).

It was elaborated and simulated in MATLAB 6.5 the structure of the automatic closed loop system with model of object with inertia and time delay with PID controller with adaptation contour of the tuning parameters.

As a result of the study of the automatic control system with the designed adaptive PID algorithm it can be concluded:

1. The transfer coefficient of the object k_0 it has been varied more than 10 times, and the time constant and time delay within the limits: $0{,}1 \le \tau/T_0 \le 10, \tau > 10\ s, T_0 > 5\ s$
2. The proposed algorithm corrects the transfer coefficient k_p of the PID controller with goal to obtain the performance of the system with overshoot σ≤20% with the absolute error ε = 0.05 from the value of the output signal of the automatic control system.

Keywords: *model of the object with inertia and time delay, PID algorithm with auto-tuning, adaptive control, adaptation mechanism.*

References

1. КУДИНОВ, Ю.И., КУДИНОВ, И.Ю., АРХИПОВ, Н.А., СУСЛОВА, С.А. Определение закона управления сложным тепловым объектом. В: *Промышленные АСУ и контроллеры,* 2004, №12, сс. 24 - 26.

2. ШУБЛАДЗЕ, А.М., УЛАНОВ, А.Г., ТКАЧЕВ, В.П., ГУЛЗЕВ, В.С., ЛАНЧЕНКО, Н.П. Адаптивные промышленные регуляторы. В: *Приборы и системы управления,* 1981, №7, сс. 15-16.