ODESSA NATIONAL ACADEMY
OF FOOD TECHNOLOGIES

IX ANNUAL SCIENTIFIC CONFERENCE

INFORMATION TECHNOLOGY AND AUTOMATION – 2016

Proceedings

Odessa
October 11-14
2016

CONTENTS

UDC 62-503.57

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RESEARCH OF SELF-TUNING ACS WITH VARYING TRANSITION COEFFITIENT CONTROL OBJECT OF TECHNOLOGICAL TYPE

In this thesis the research of the band pass filtering utilization for extracting free motion of the ACS in order to provide self-tuning of such system is provided.

Introduction. Many factors have influence on technological process variables when this process is contemplated as control object (CO). These factors are usually represented as non-controllable coordinate and parametric disturbances. Parametric disturbances more often reveal themselves in CO transition coefficient changes. On a number of occasions it can change in a wide range – 2…10 times in comparison to initial value [1]. Traditional automatic control system (ACS) with this CO would loose stability because controller parameters remain the same. That's why self-tuning of the controller is a non-alternative instrument of compromise saving between quality factors and processes stability in ACS with such CO.

A lot of known self-tuning ACS utilize specially organized search movements in ACS for identifying current changes in CO transition coefficient. Besides, there are dangers of violations in regimes and regulations in CO operation. Nevertheless identification in the closed-loop circuit of the ACS can be carried out using those changes of the controlled variable $y(t)$ of the CO which arouse naturally as the result of coordinate disturbances impact [2]. This is favoured by the fact that for CO of technological type parametric disturbances spectral density is much more lower in frequency range if compared with spectral density of coordinate disturbances [3]. This specific feature distinguishes CO of technological type from many mobile and electromechanical types.

In fact, occurs the possibility of using band pass filtering to divide low-frequency part $y_l(t)$ of $y(t)$ changes, which is generated by the influence of coordinate disturbances and high-frequency part $y_n(t)$, which is the result of the noises impact, from low-frequency part $\widetilde{y}(t)$ of the controlled variable movement. The latter characterizes own movement of the ACS, in particular, changes of the CO transition coefficient. The topic of band pass filtering is given in more detail in [4].

Problem statement. Let's examine in more detail the block diagram and the working principle of the self-tuning ACS (STACS) with passive identification.

During operation CO receives impact from external non-controllable coordinate $f_k(t)$ and parametric $f_p(t)$ disturbances, and also from high-frequency noises $f_n(t)$, which in general represent stochastic processes. When changing operating modes, and also, as a result of equipment degradation processes, changes, specifically, CO transition coefficient k_o. ACS controller stabilizes controlled variable $y(t)$ on the level y^z, suppressing low-frequency part $f_k(t)$, remaining functional in some narrow range of k_o. For noises suppression $f_n(t)$ low-frequency filter is used in the system (LFF).

Substantial parametric disturbances $f_p(t)$, which excite k_o changes, require tuning of the transition coefficient k_r of the ACS controller in real time for saving the stability of the system. This function in STACS is implemented by the self-tuning block (see fig. 1). It consists of CO model, which receives as its input control impact $u(t)$ of the ACS controller. Controlled variable $y(t)$ of the CO and the output of its model $y_m(t)$ go to the inputs of band pass filters. They suppress the sequels of coordinate disturbances $f_k(t)$ and noises $f_n(t)$ influence on $y(t)$ and $y_m(t)$. In the outputs of the filters the signals $\widetilde{y}_a(t)$ and $\widetilde{y}_{ma}(t)$ are formed, which characterize own movement of the ACS. This topic is given in detail in [4].

Dispersion estimations evaluations on sliding time interval τ_{OC} averages the signals $\widetilde{y}_a(t)$ and $\widetilde{y}_{ma}(t)$, evaluating the estimations of their dispersions $\hat{D}_{\widetilde{y}_a}(t,\tau_{oc})$ and $\hat{D}_{\widetilde{y}_{ma}}(t,\tau_{oc})$, which, as shown in [4], are proportional to the squared transition coefficient values $k_o^2(t), k_m^2(t)$ of the CO and its model. the level of CO dispersion estimation $\hat{D}_{\widetilde{y}_a}(t,\tau_{oc})$ by virtue of model transition coefficient $k_m(t)$ change. In other words, CO model and parametric controller k_m in the real time implement the identification of the model transition coefficient $k_m(t)$, by tracking CO transition coefficient $k_o(t)$.

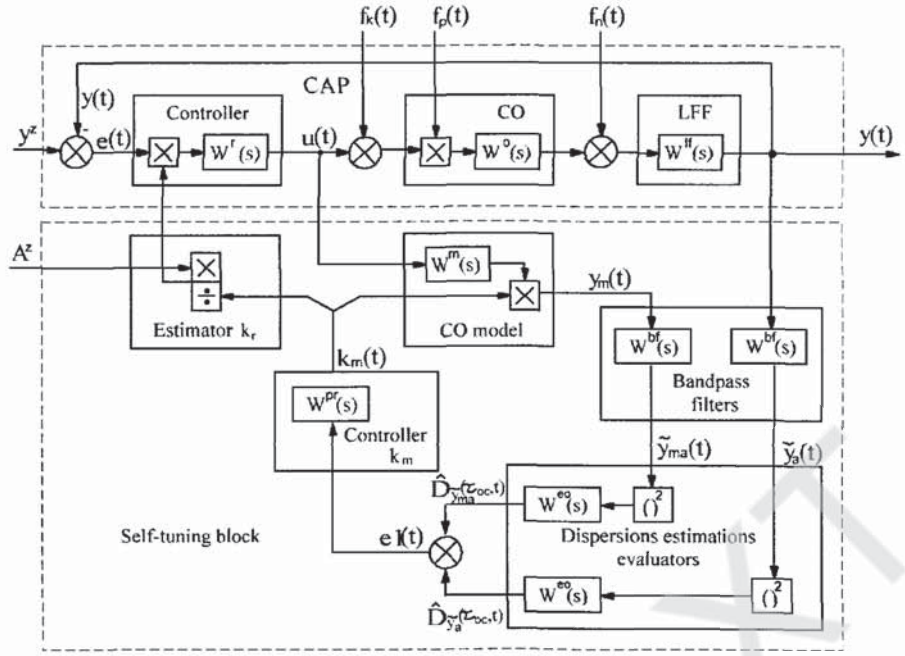

Fig. 1. Block diagram of the STACS

The current value of $k_м(t)$, which is proportional to $k_o(t)$, from the output of the controller k_m goes also to the evaluator k_r, which calculates the value of $k_r(t)$, on the assumption of the product constant $A^z = k_o \cdot k_r$, where A^z – some constant, which sets the desired appearance of the transient process in ACS. Thereby ensuring of the stable operation of the ACS main circuit during CO transition coefficient changes.

In the STACS structure a couple of non-linearities are presented, that's why analytical solving of the analysis and synthesis problems is complicated. Known solutions have approximate character and have been obtained for some particular cases. Considering this fact, as an instrument for STACS research was chosen computer modeling in Simulink of the MatLab environment.

In the report the conditions and the plan of carrying out comparative researches are announced, the analysis of computer experiments is carried out, revealed the influence of external disturbances spectral composition changes and noises on the quality factors of the STACS operation with different parameters of the self-tuning block.

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