Available online at www.sciencedirect.com

ScienceDirect

Procedia Engineering 150 (2016) 266 – 270

Procedia Engineering

www.elsevier.com/locate/procedia

International Conference on Industrial Engineering, ICIE 2016

Defining of the Power of a Control Loop Actuator

B.T. Budai*

Ural Federal University named after the first President of Russia B.N.Yeltsin, 19 Mira street, Ekaterinburg, 620002, Russia

Abstract

The input harmonical signal is usually used to define the power consumed by actuators of control loops of regulative systems. It's shown that if there are no limits imposed on the type of input disturbance, the power consumption may increase up to two times.

Peer-review under responsibility of the organizing committee of ICIE 2016

Keywords: control loops; regulative systems; input signal; signal of error; power of actuators; astatism

1. Introduction

In mechanical engineering it appeas a need to design control loops (CL) for regulative systems of high precision [1–5]. A typical structure of a CL is represented on the fig.1a, where $K_c(p,n)$, $\Delta K_c(p,n)$ – transmission factors of the CL and control error (CI), respectivelly, as functions of the Laplas transformation parameter p and astatism of n-th order, $K_s(p)-$ transmission factor of the sensor error, $K_k(p)-$ transmission factor of the corrector filter (KF), $K_a(p)-$ transmission factor of the CL actuator.

The extremely unfavorable input disturbances $x_m(t)$ can't be reproduced in time at output of CL with actuators of small transmission factors $K_a(p)$, so large dynamic errors of reproduction of input disturbances exist in this case.

On the contrary, too powerful actuators lid not only to the propotional growth in mass but as well to nonlinere effects, such as clearances and insensitive zones $\Delta x_м(t) \approx x_м(t) - \hat{x}_м(t)$ [5-8].

* Corresponding author. +7-909-702-0590; fax: 8-343-375-93-50.
E-mail address: buda080316@rambler.ru

1877-7058
Peer-review under responsibility of the organizing committee of ICIE 2016
doi:10.1016/j.proeng.2016.07.001

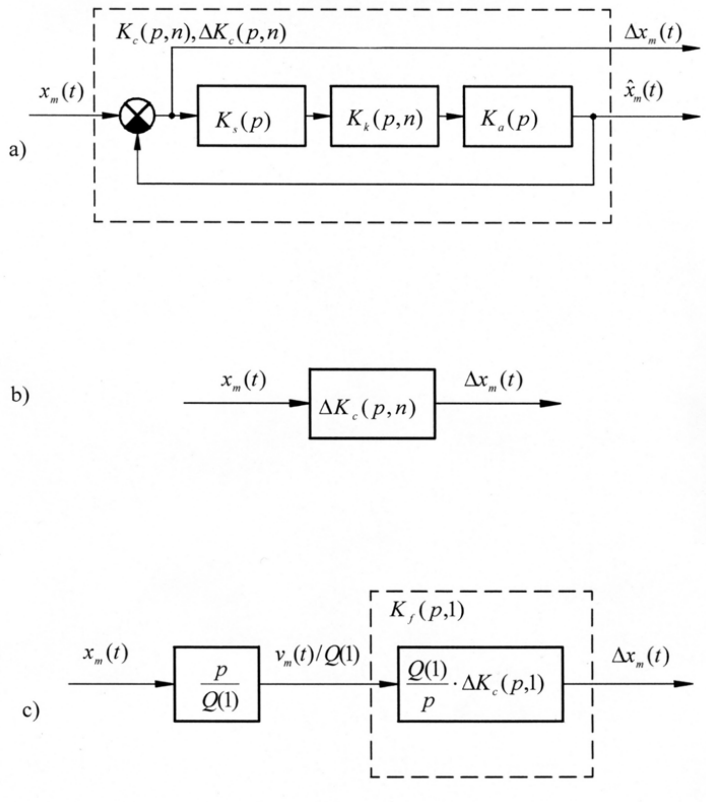

Fig. 1. Equivalent transformation block diagram KU.

Thus, there is a problem which concerns the estimation of the highist possible unfaverable disturbances, that determine the power of CL actuators. It's considered that fluctuation errors are determined by the band of system and don't exceed the dynamic error, and errors due to clearances and friction don't exceed the fluctuation error [5].

2. Etimation of the extremely unfavorable disturbances of the loops

It's known that maximum power for actuator rotation is proportional to square of the maximum input signal of the CL actuater, that may be reprisented as

$$U_{a.m}(t) \approx \Delta x_m(t) \cdot K_s(p) \cdot K_c(p,n) \cdot K_a(p), \tag{1}$$

where

$$\Delta x_m(t) \approx x_m(t) \cdot \Delta K_c(p,n).$$

In accodence with (1), lat's find the maximum value of the error corresponding to the maximum value of the signal requaered to turn the CL actuater.

In control loops (CL) of regulative systems, for example, in servo optical mechanics systems, it needs to evaluate the maximum amplitude ΔA_m of the control error $\Delta x_m(t)$ caused by extremely unfavorable input disturbance $x_m(t)$ [1–5]