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EXPERIMENTAL DEVICE FOR TESTING OF SERVOMECHANISMS OF THE PASSIVE OPTOELECTRONIC RANGEFINDER

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Abstract: *It is necessary to use quite a big gear ratio (from 150 to 300) to ensure an accurate control of the angular motions of passive optoelectronic rangefinder (POERF). Used zero-backlash gearings together with the features of rolling-contact bearings generate relatively high nonlinearities which make the achievement of demanded control accuracy of POERF complicated or even totally precluded. Experimental (Test) device for the described drives was constructed in OPROX company. The device was set into function by the composite authors of this article and at the moment, relevant measurements are being taken. The aim is to use the testing measurements taken on the device in order to design and verify a method and SW for initial and continuous identifications of the parameters of POERF nonlinear model of servo-drive. In this article we will provide basic information on mechanical design of the experimental device construction, control and power parts of servo-drive and on communication protocol including the measurement protocol (output data).*

Keywords: ***Experimental (Test) device, servo-drive, nonlinear system, passive optoelectronic rangefinder (POERF), measurement..***

1. Introduction

During the work on project KT-TA3/103 between 2007 and 2009 we discovered that zero-backlash servo-drives suitable for POERF are very nonlinear and it is impossible to achieve the demanded control quality when control algorithms based on linear theory of automatic control are used (Composite authors, 2009).

At that time, preliminary theoretic analyses were made (Čech & Jevický 2009), and that verified the results acquired in experiments with servo-drives of POERF. Nevertheless, it was obvious that it is necessary to accomplish systematic experiments in order to form the basis for design of nonlinear model of servo-drive that must be implemented into servo-drive controllers so as to achieve the demanded quality of control. At the same time it was obvious that in order to accomplish these operations it will be necessary to construct a specialized experimental device.

The aim of this article is to acquaint the specialists with the experimental device construction. In the final part, examples of measurement results are stated to prove that zero-backlash drive with a set structure is really nonlinear (Fig. 1).

2. Design of the experimental device

Experimental device consists of the device, control computer with particular SW and of power supplies 9 (Fig. 1). Output shaft (controlled object) 1 is placed with the use of rolling-contact bearings in the frame 2 of the device. The frame of the device 2 is pivoted on a base plate 3 with the use of a shaft 4. For basic experiments that are being currently accomplished, the frame 2 is rigidly fixed to the base plate 3 by the use of stopping mechanism with a fixation screw.

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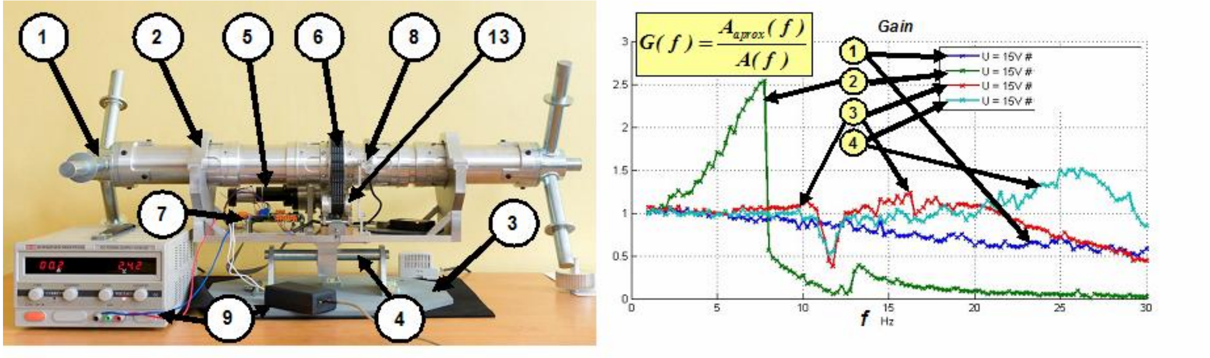

Fig. 1 General view of the Experimental device and one example of the measurements – the Gain of whole system in dependency on belt tightening (1 – without belt, 2 – poorly tightened belt (backlash), 3 – sufficiently tightened belt (zero-backlash), 4 – very tightened belt).

On both sides of the output shaft 1 there are three side shanks where discs of different weights can be placed and thus it is possible to change the moment of inertia of the output shaft (controlled system) in relatively high limits (bounds). The moment of inertia of the output shaft without the weights and side shanks (Fig. 1) is 0,014125 kgm^2. Maximal moment of inertia (6pcs of discs ea. 5 kg) is 1,205460 kgm^2. Angular displacement of the output shaft 1 towards the frame 2 is measured by means of optic incremental sensor “SIGNUM RESM angle encoder” 8 by company RENISHAW plc, UK.

The respective servo-drive consists of mechanical gearings, DC motor 5 with accessories, control and power unit 7 and power supplies 9. Mechanical gearings comprise a harmonic drive gearing and a belt drive 6. The belt drive is based on an indented belt PowerGrip® GT3 625 5MGT 25. We have driving pulleys with 26, or 39 or 52 teeth at disposal so the gear ratio of the belt drive can be i_2 = 1,5 or 2,0 or 3,0. As a result we can make experiments with overall gear ratios $i_C = i_1 \cdot i_2$ = 150 or 200 or 300. Tightening indented pulley 13 is used for tightening of the indented belt.

DC motor RE 35 by company Maxon motor, www.maxomotor.com is equipped by accessories which are mounted to its shaft: Brake AB 28 and Encoder HEDL 5540. Control and power electronics unit 7 is placed on the frame 3. Electronics operates with 16 bit subsystems.

3. Conclusions

In the following period we will focus our effort on development of methodology for measurements and on design of software for automatic evaluation of measurements. The design of nonlinear model of the servo-drive will be in progress concurrently with the evaluation of sufficiently extensive sets of measurements..

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