TECHNICAL UNIVERSITY OF CLUJ-NAPOCA

ACTA TECHNICA NAPOCENSIS

Series: Applied Mathematics and Mechanics
Vol. 55, Issue IV, 2012

THE PRECISION AND SENSITIVITY OF THE SPEED REGULATOR ON THE FUNCTIONING OF THE IMPULSE DRIVE IN AUTOMATIC ADJUSTMENT REGIME

Tudor Cristian BALTARU, Maria Felicia SUCALĂ

Abstract: *In this paper it's presented the response precision and sensitivity automatic adjustment system composed of a impulse drive and a centrifugal electro-mechanical speed regulator.* ***Key words:*** *speed regulator, impulse drive, system of automatic adjustment.*

1. INTRODUCTION

Automatic systems with continuously drive speed represents an effective way to increase productivity and improve machine operating conditions.

The automatic adjustment system efficiency depends heavily on the speed response and the sensitivity of the system.

Impulse drive are a part of category with mechanical continuously drive speed and has a number of advantages which recommends to be used in automatic systems adjustment [4].

These advantages are: adjustment of the zero crossing speed thus eliminating the need for clutches; allowing speed control while driving and under load; motion transmission is made without sliping and is suitable for automatic ajustment.

2. DESCRIPTION OF IMPULSE DRIVE AND THE CENTRIFUGAL SPEED REGULATOR

Impulse drive used in automatic adjustment system is a drive pulse type Gusa (fig.1) [2],[3],[4] composed of three identical mechanisms with variable length rod related in parallel.

The dimensions of the elements of mechanism are: $\ell_1=O_1A=30$ [mm]; $\ell_5=O_3B=80$ [mm]; $d=O_1O_3=260$ [mm]; $\ell_6 = 120\ldots165$ [mm], the speed shaft conductor $n_1=1420$ [rot/min] and output shaft speed $n_2=30....230$ [rot/min].

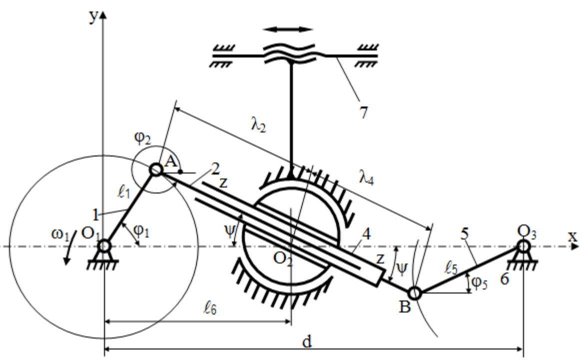


Fig. 1 Mechanisms with variable length rod

The centrifugal electro-mechanical speed regulator used in the automatic adjustment system (fig. 2), is composed from: support 1, axis 2 leaned against in this support, on which is fixed leaf spring 4, with weight 7. On the spring are fixed electrical contacts 5 and 6 that can close contacts on the support 8. The length in overhang of the spring (ℓ) is adjustable by changing position of mobile carrier 3.

When impulse drive operates in steady state, spring 4 has an intermediate position,and contacts 5 and 6 are being opened.

The rod 2 of the centrifugal speed regulator receives the movement from the driven shaft of the impulse drive through a gear transmission.

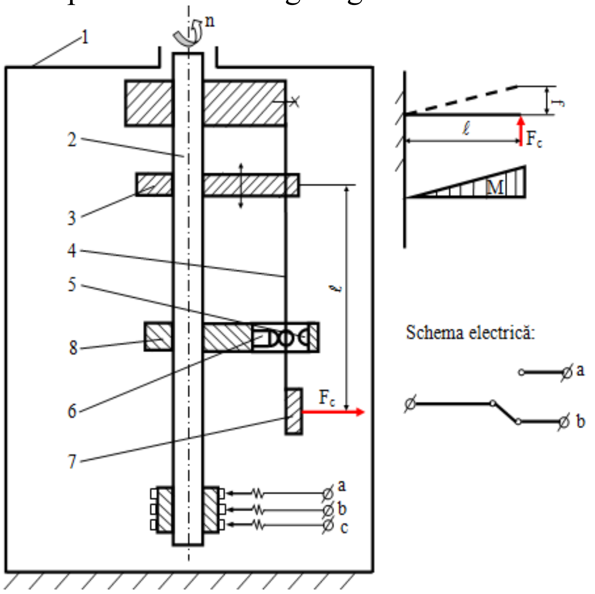


Fig. 2 Centrifugal electro-mechanical speed regulator

When the speed driven shaft and the axis 2 increases, it closes contact 5 which engages in a sense the actuator mounted on the adjustment mechanism screw of the impulse drive, and when the speed decreases it closes contact 6 and engages the actuator in reverse.

Real characteristic of centrifugal electro-mechanical speed regulator is presented in figure 3 [1].

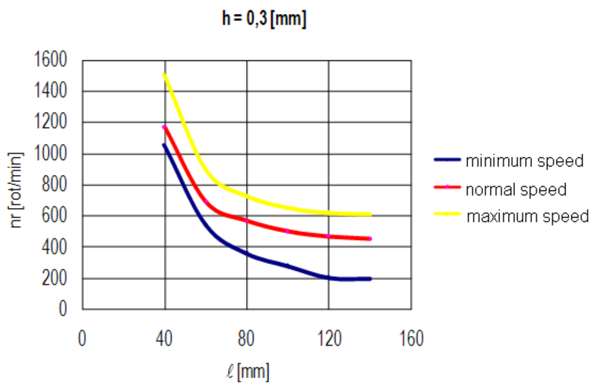
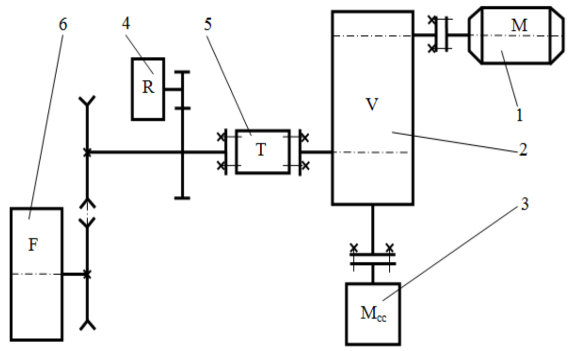


Fig. 3 Characteristic of centrifugal speed regulator

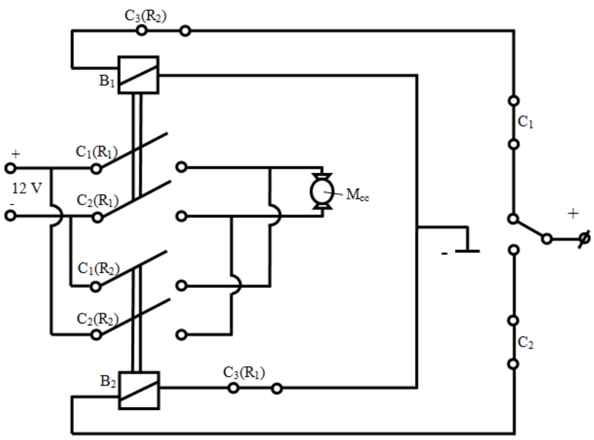
3. THE INSTALLATION USED FOR EXPERIMENTAL TESTS

In order to establish the sensitivity the automatic adjustment system and to experimental determine the precision system response to changes in the resistant moment, we had to make a stand (fig. 4), composed of:

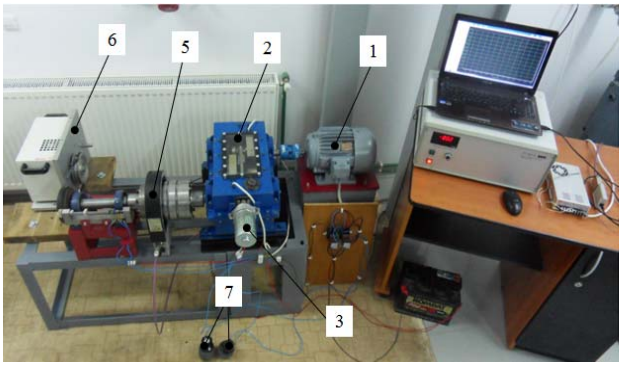
1. asynchronous electric motor, (3 kW);
2. impulse drive;
3. DC motor (used to vehicle direction Hyundai);
4. centrifugal electro-mechanical speed regulator;
5. torque transducer T12;
6. loading and braking unit PT 500.05.



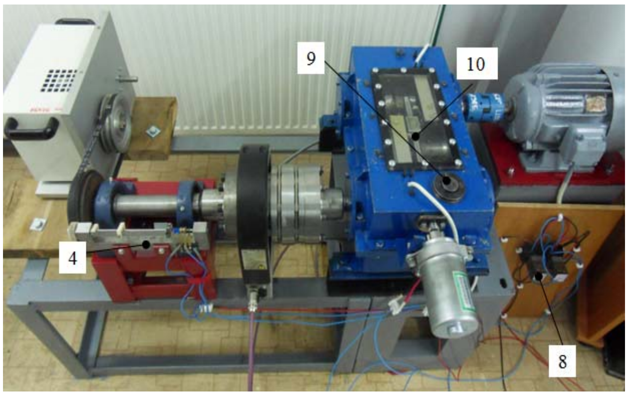
a.



b.



c.



d.

Fig. 4 Stand for experimental attempts

In order to use a impulse drive in a speed automatic adjustment scheme, to be able to automatically adjust the transmission report, the adjustment screw mechanism 10 (fig. 4) driven shaft speed of impulse drive, is being in rotation movement (in one sense or another) by a DC motor ordered the centrifugal speed the regulator through some relee 3, the wiring diagram being shown in figure 4 b, and in one adjustable length ℓ_6, of the oscillation adjustable mechanism that forms the impulse drive is being modified.

The length ℓ_6 is read at indicator 9 (fig. 4 b), graduated in degrees. The correlation between length ℓ_6 and indication on the indicator diagram is given in figure 5.

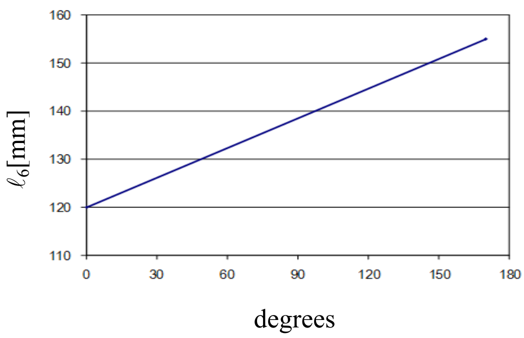


Fig. 5 Diagram for the length ℓ_6

Theoretical values of mean angular velocity respectively corresponding speed on the output shaft, as well as the transmission ratio, for four values of length ℓ_6 are given in table 1.

Table 1

Angular velocity values, output shaft speed and transmission ratio

Input speed n_1 [rot/min]	**Length** ℓ_6 [mm]	**Velocity average angular** ω_{med} [rad/s]	**Output speed** n_2 [rot/min]	**Transmission report** i
1420	120	22,99	200,44	7,483
	135	13,95	133,26	11,256
	150	8,36	79,88	18,778
	165	3,8	36,29	41,337

To follow how speed varies depending on the moment resistant between impulse drive and loading and braking unit is introduced a digital torque transducer T12 produced by HBM presented in figure 6.

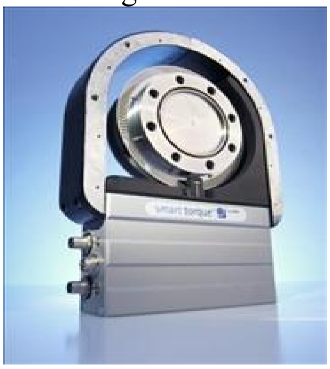


Fig. 6 Torque transducer

4. EXPERIMENTAL TEST RESULTS

Experimental test results were obtained using T12 Assistant software produced by HBM. In figures 7, 8, are presented the graphic speeds at the output impulse drive for two lengths of the bearing pedestal ℓ_6 = 120 [mm] and ℓ_6 = 135 [mm].

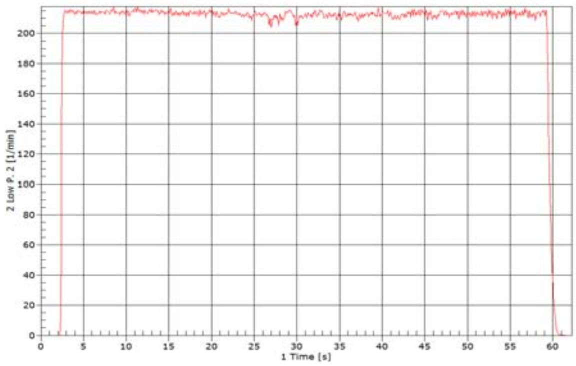


Fig. 7 The variation of the speed driven shaft of impulse drive for length ℓ_6 = 120

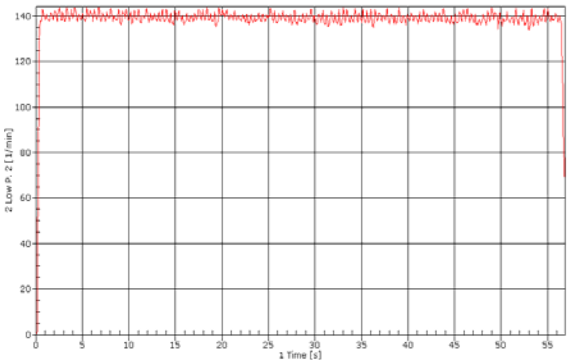


Fig. 8 The variation of the speed driven shaft of impulse drive for length $\ell_6 = 135$

In figures 9, and 10 are presented the variation of the speed driven shaft of impulse drive for two lengthes to the variation of the moment resistant graphs. It can be noticed that the application of a resistant moment driven shaft is approximately reduced by 12 [rot/min].

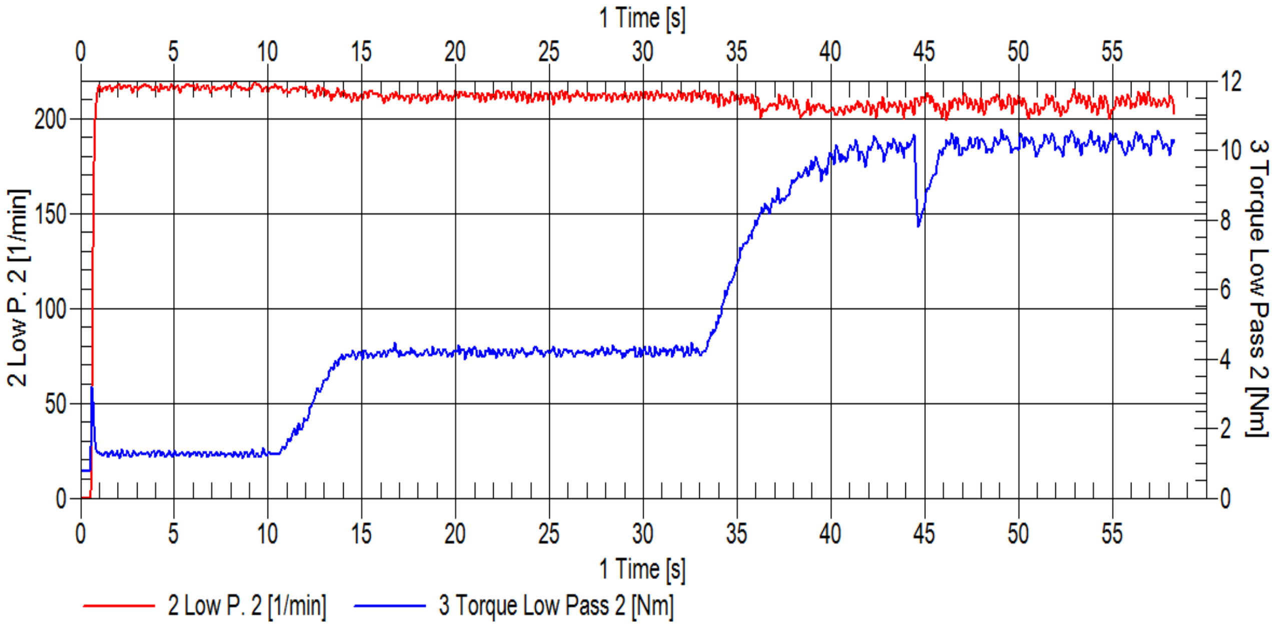


Fig. 9 The variation of the speed driven shaft of impulse drive for length $\ell_6 = 120$ to the variation the moment resistant

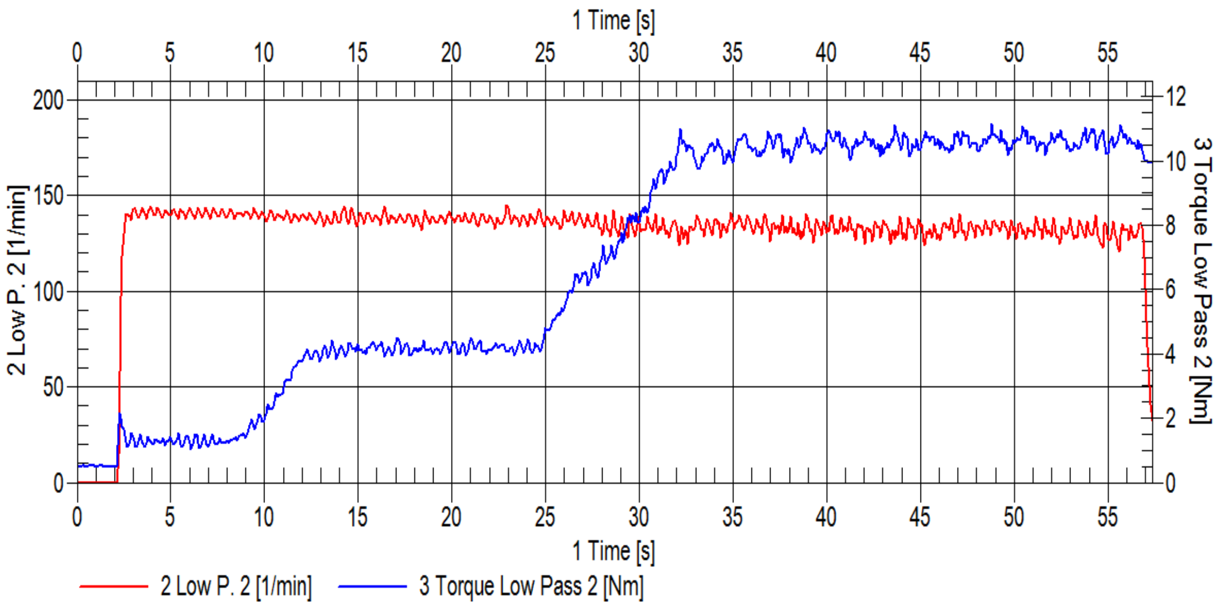


Fig. 10 The variation of the speed driven shaft of impulse drive for length $\ell_6 = 135$ to the variation the moment resistant

In order for the impulse drive to function in automatic adjusment regime, considering the speed we want to adjust and the gear ratio regulator of its calibration diagram, in figure 3 we can read the length value of interloking ℓ of the elastic plate of the regulator coresponding to a speed for which we adjust and maintain constant speed, than the phase induction motor is started, it varies the resistant moment from the brake and are being registered graphical relations impulse drive value.

Figures 11 and 12 present the graphs of variable speed exit and the regulator response to the variation of the resistant moment for the two lengths. At length ℓ_6 = 120 mm in order to maintain the same speed of the driven shaft of the impulse drive, the legth value of interloking ℓ of the elastic plate of the regulator it must be fixed at 46 mm, and for a legth ℓ_6 =135mm at 72 mm. We can observe that increasing the resitant moment the speed at the exit of the impulse drive it's not reduced in the same repart, existing there a process of adjustment and automatic maintenance of constant speed. The response time of the control system is 20 seconds.

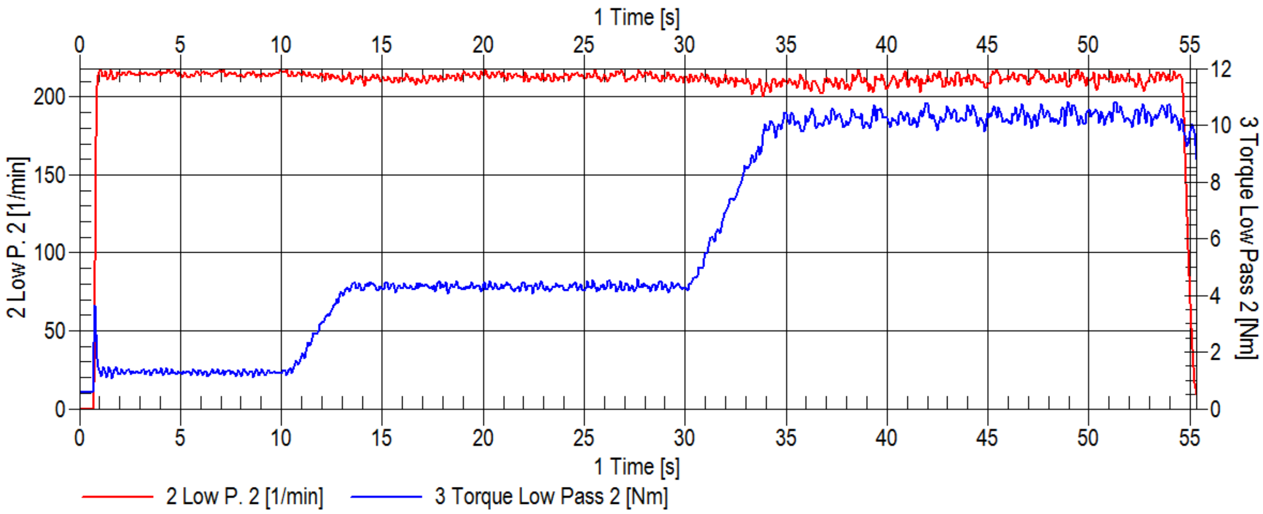


Fig. 11 The variation of the speed driven shaft of impulse drive for length ℓ_6 = 120 to the variation the moment resistant and response regulator

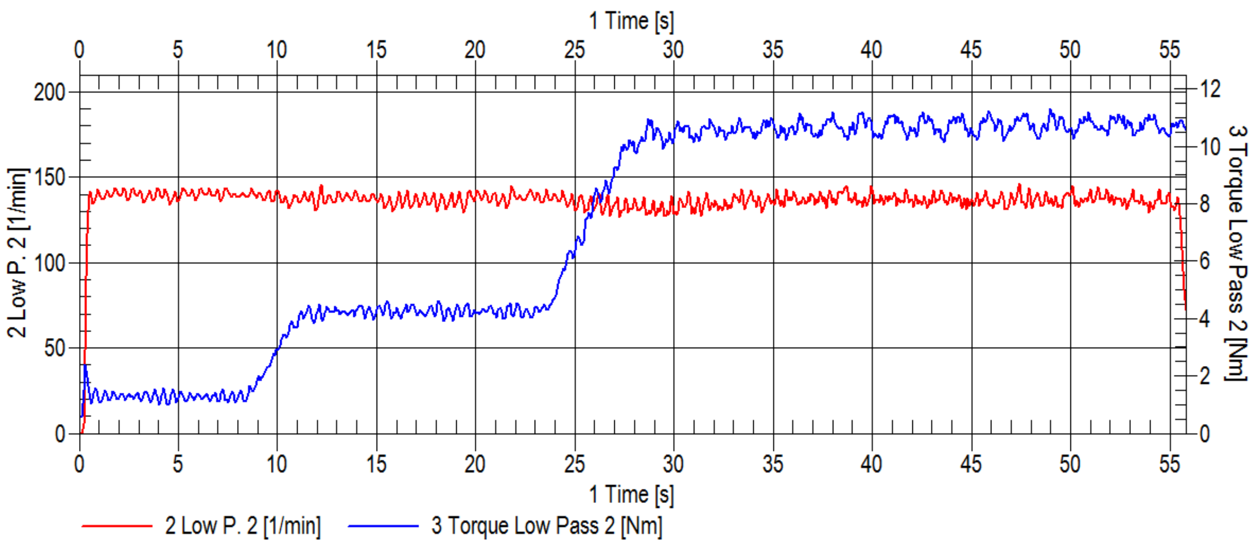


Fig. 12 The variation of the speed driven shaft of impulse drive for length ℓ_6 = 135 to the variation the moment resistant and response regulator

5. CONCLUSION

The automatic control system qualities can be derived from the above figures following the experimental results. It can be seen that for any variation of the resistant moment, the system reaches a steady position close or identical to the original.

Depending on the time variation of the resistant moment the response time of the control system is rather short, up to 20 seconds.

6. REFERENCES

[1] Baltaru, T., Sucală, M., *Design of centrifugal regulator speed used in automatic control system of an impulse drive,* SIDOC Project – Doctoral students' session, Technical University of Cluj-Napoca, 2012.

[2] Miloiu, G., Dudiță, F., *Transmisii mecanice moderne*, Editura Tehnică, Bucureşti, 1980.

[3] Miloiu, G., Dudiță, F., *Transmisii mecanice moderne*, Editura Tehnică, Bucureşti, 1971.

[4] Sucală, M., *Teză de Doctorat, Dinamica vatriatoarelor cu impulsuri cu reglare automată,* Institutul Politehnic Cluj-Napoca, 1987.

PRECIZIA SI SENSIBILITATEA REGULATORULUI DE TURAȚIE ASUPRA FUNCȚIONĂRII VARIATOARELOR CU IMPULSURI ÎN REGIM DE REGLARE AUTOMATA

Rezumat: În această lucrare este prezentată precizia de răspuns şi sensibilitatea unui sistem de reglare automat format dintr-un variator cu impulsuri si un regulator centrifugal mecano-electric de turație.

Tudor Cristian BALTARU, Phd Stud, Technical University of Cluj-Napoca, Mechanical System Engineering Department, baltaru_tudor@yahoo.com.

Maria Felicia SUCALĂ, Prof. Dr. ing., Technical University of Cluj-Napoca, Mechanical System Engineering Department, Felicia.Sucala@omt.utcluj.ro.