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NUMERICAL SIMULATION OF THE SERVO MECHANISM FOR ADJUSTING THE CAPACITY OF THE RADIAL PISTON PUMPS

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Abstract: *The paper presents the simulation of static and dynamic behavior of system capacity control radial piston pumps using the program AMESim.*

Keywords*: simulation, pumps, rung signal, sinusoidal signal*

1. Introduction

To analyze the static and dynamic behavior of the control system capacity of radial piston pumps, was used a powerful and performant graphical program, AMES / Imagine. For the composition of the simulation models were used standardized symbols specific hydraulic elements existing in the library program.
AMESim is a simulation environment built on multiport considerations. The exchange of information between the components is bidirectional and thus made fewer lines of communication. At the same time the simulation environment shapes almost exactly real models of the dynamic systems simulated. Another important feature of the program is the automatic choice of the method of integration of the systems of equations that can be adapted during simulation according to the characteristics of equations.
From the user point of view, the program is a suggestive graphical interface that displays the evolution of the whole system during the simulation process.

2. Structure for simulation of servo

In fig. 1 is shown the structure for simulation of servo positioning. It is then specified the correspondence between the components of the simulation model and the physical model elements [1]. The analyzed system is the real mechatronic control system eccentricity / flow, which is composed of:
- Electro-hydraulic proportional distributor 4/3 with center closed - Item 8;
- Supply group with oil under pressure - Item 3, 4 and 2;
- Tank - Item 1;
- Position transducer - Item 13;
- Compensator - Item 16;
- Linear hydraulic motor + inertial load + viscous frictions - Item 14, 15, 11, 10 and 12;
- Signal generator - Item 7.

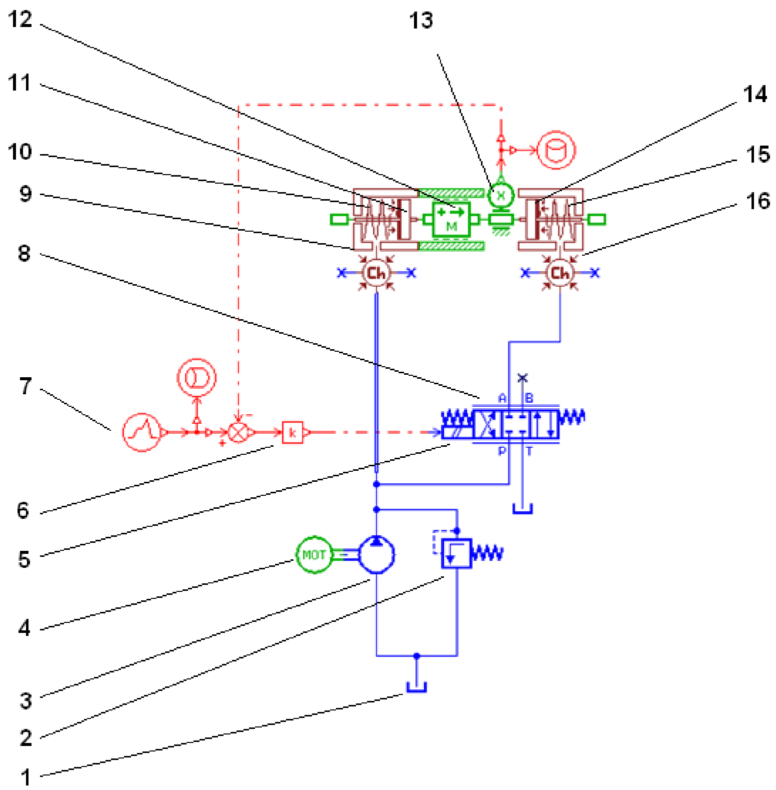
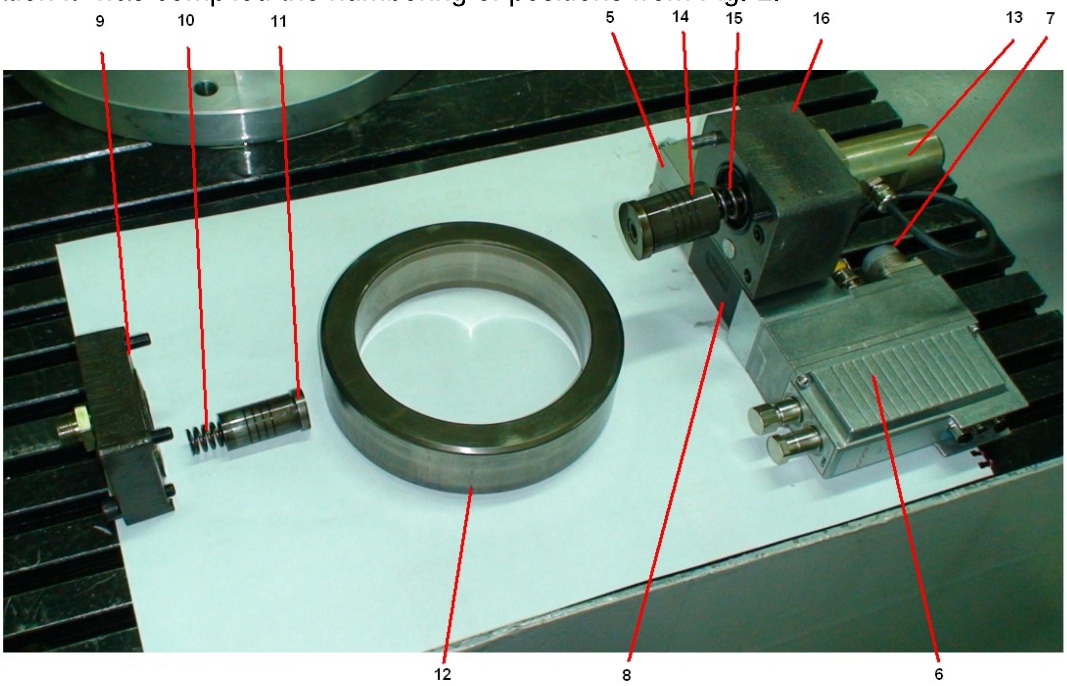


Fig.1 The network for simulation of the servo control of radial piston pump capacity

Their correspondence with the real control system eccentricity is shown in Fig. 2. For an easy identification it was complied the numbering of positions from Fig. 1.



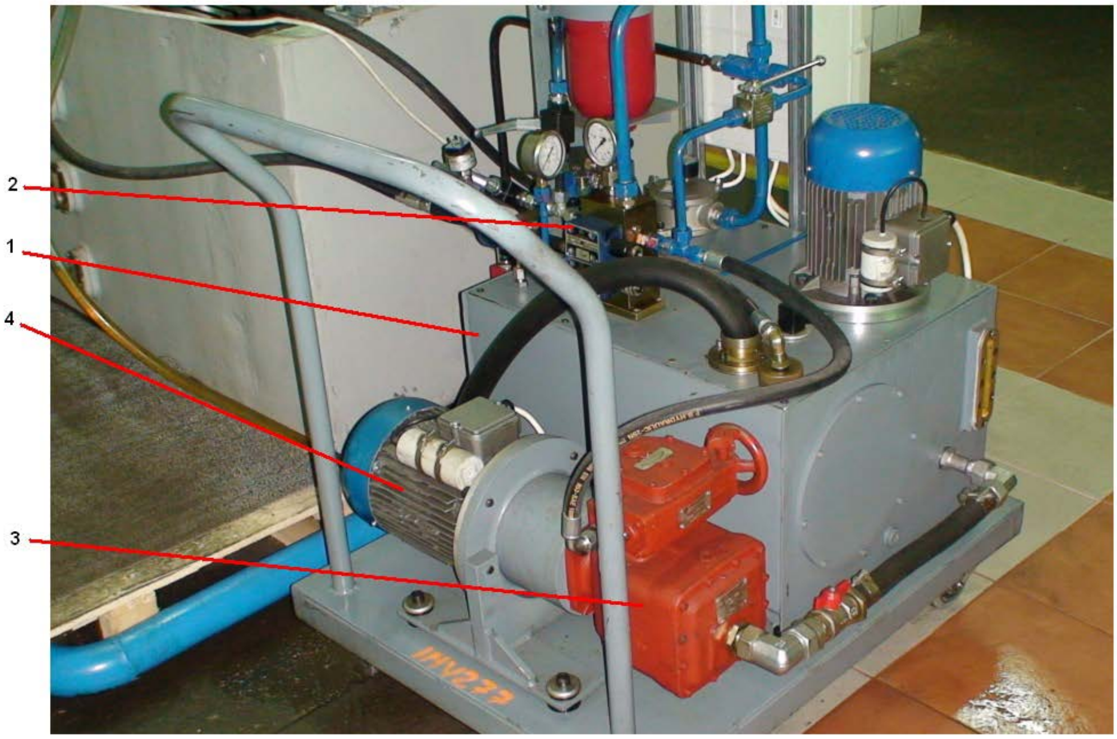


Fig. 2. Physical structure of the positioning system for adjusting the eccentricity

In these pictures are distinguished in the following:

1. tank;
2. pressure limiting valve;
3. Volumetric pump
4. electric motor;
5. electromechanical converter;
6. electronic compensator;
7. the command prescription channel;
8. proportional distributor body;
9. small piston chamber;
10. small piston spring;
11. piston with small area;
12. inertial mass (sliding ring);
13. inductive position transducer;
14. piston with large area;
15. piston spring with large area;
16. large piston chamber.

3. Static and dynamic characteristics of the system

To determine the static and dynamic characteristics of the system, it was controlled by triangular electrical signals voltage step and sinusoidal type in the field (0 ... 10) V DC. Frequency signal, type ramp was chosen small enough to generate a quasi-static regime.The were obtained features from simulation which are presented in Fig. 3....7, the monitored parameter at the (output of the) system output being eccentricity, whose values, when used as an experimental model pump is:

$$e = (\varphi ... 5) mm.$$

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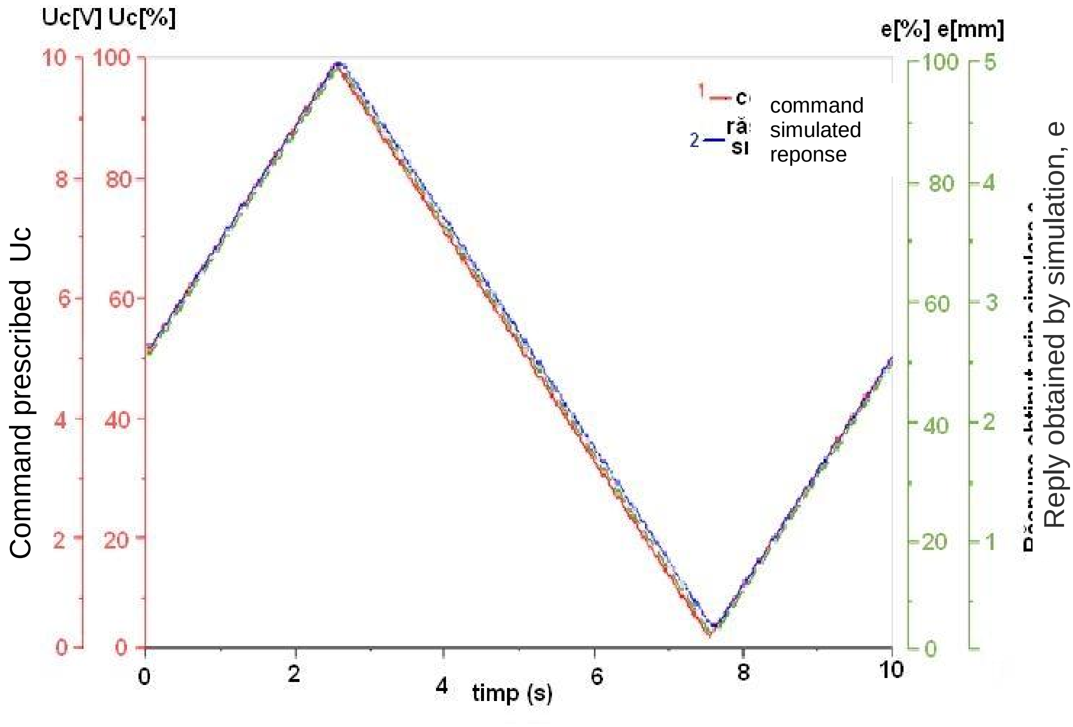

Fig. 3. System response to the ramp signal, frequency 0.1 Hz

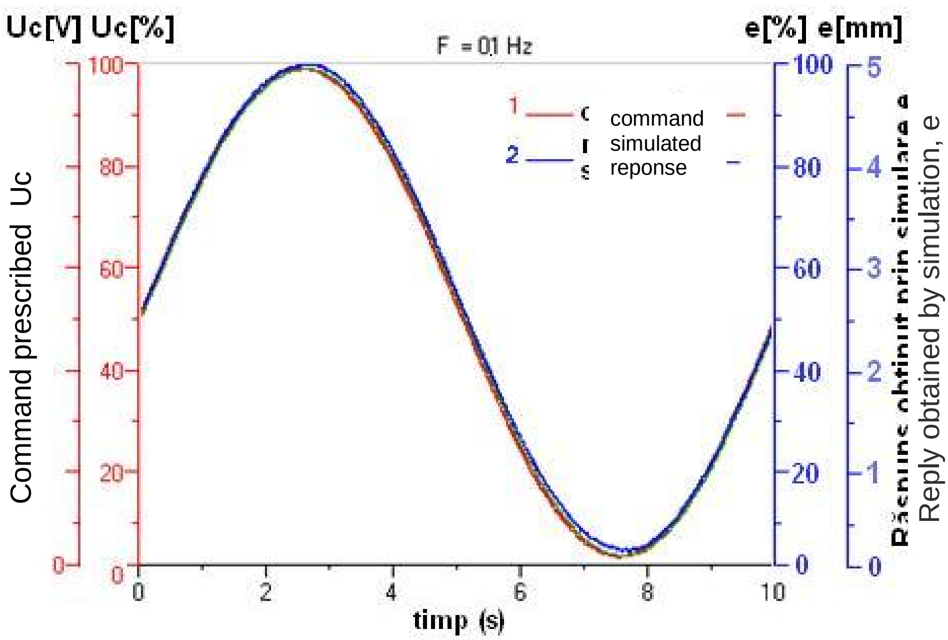

Fig. 4. System response to sinusoidal signal, frequency 0.1 Hz

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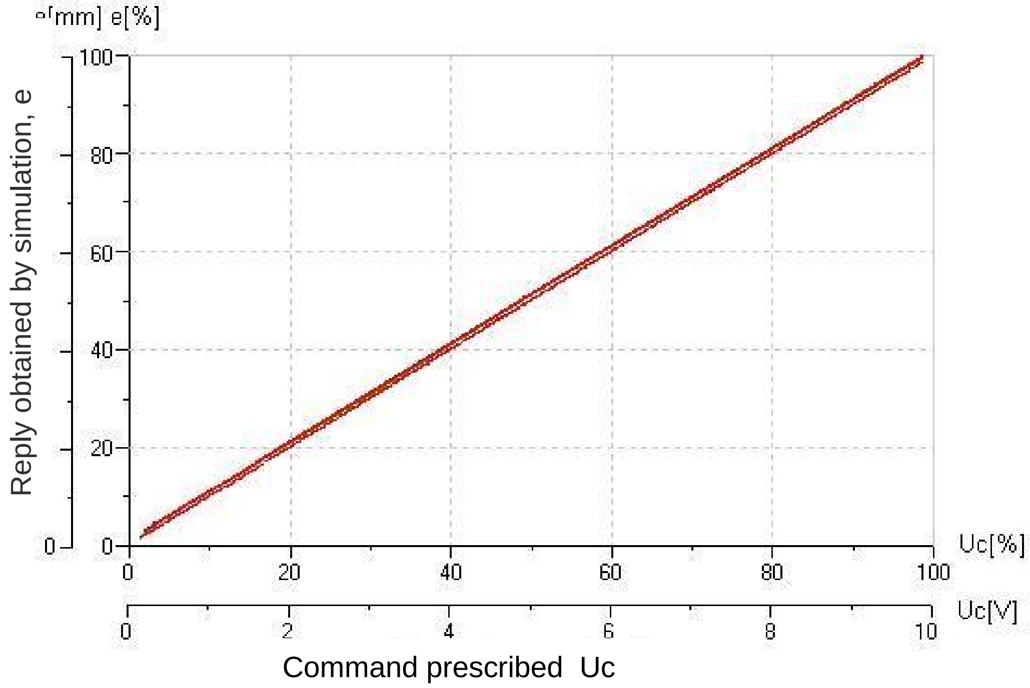

Fig. 5. Static characteristic, frequency of 0.05 Hz

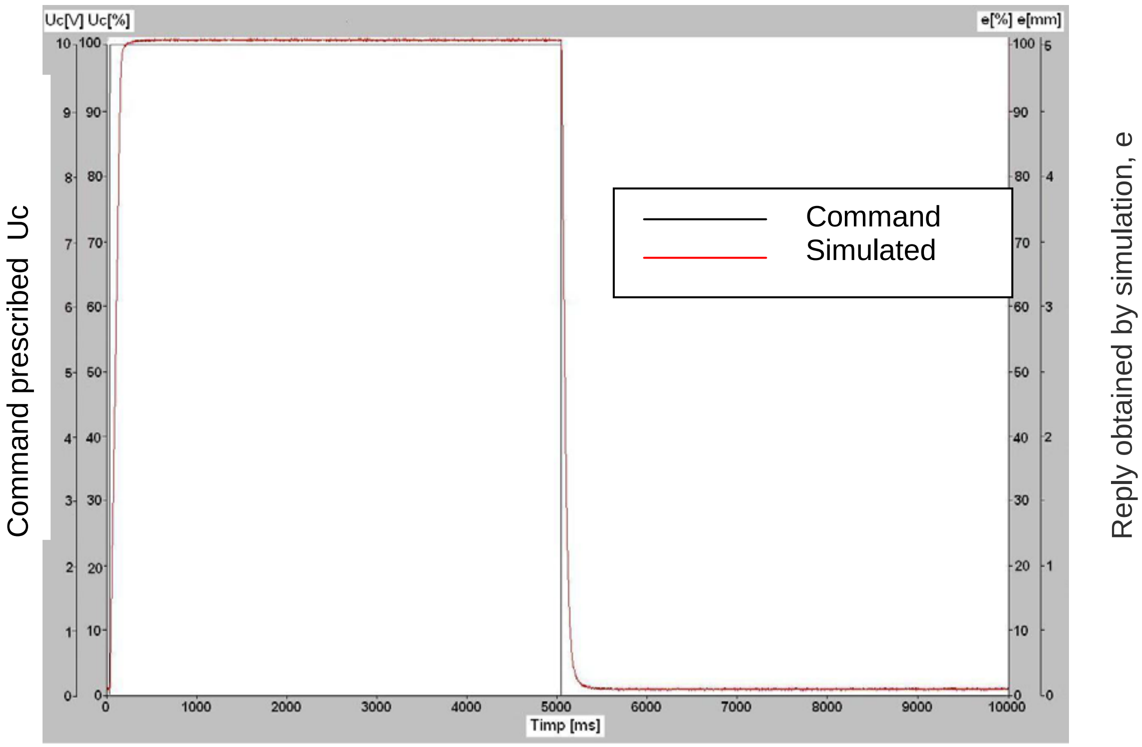

Fig. 6. Response to the signal rung

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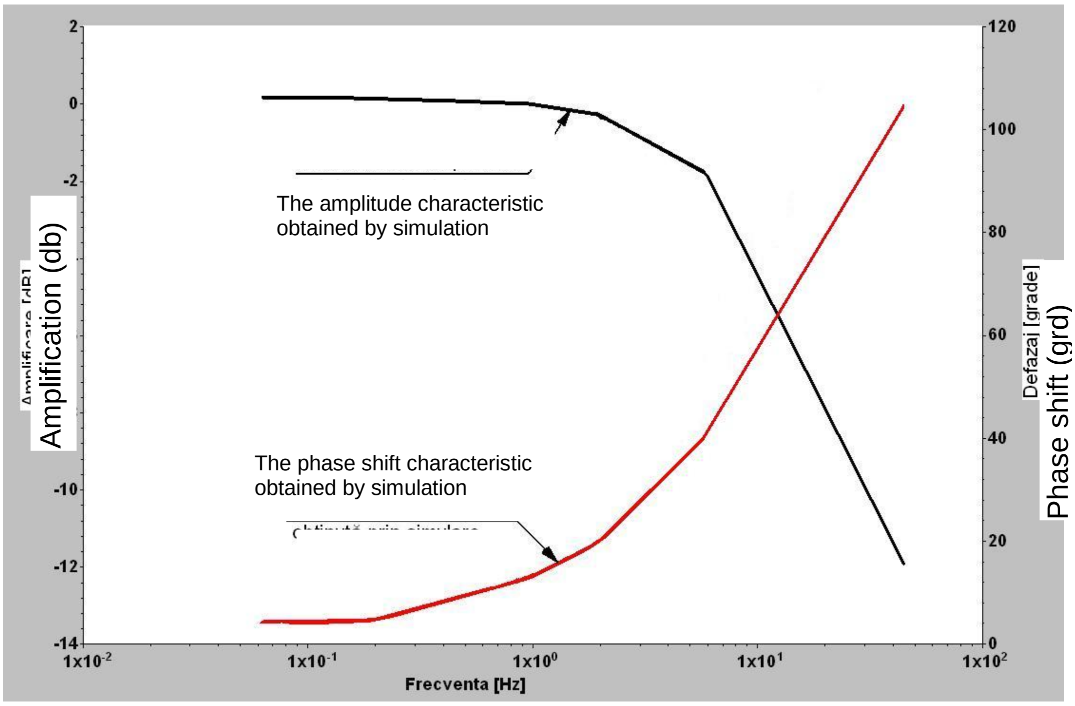

Fig. 7. Bode diagram

4. Conclusions

All features obtained using AMESim program, have very small deviations between the command and simulation which means that the obtained results simulate with a very good accuracy functioning of the control eccentricity system.
Considered the reference, the results obtained by numerical simulation will be validated experimentally. Experimental research results and comparison with the simulated results will be presented in another article.

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