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CONSTRUCTION OF A MATHEMATICAL MODEL OF THYRISTOR DEVICES IN THE MATLAB PROGRAM

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ABSTRACT
This article discusses the construction of mathematical modeling of thyristor devices in industrial enterprises.
KEYWORDS: *control unit, PI, SU, GTU, HELL, Simulink, Oscilloscope.*

INTRODUCTION

It is known that control systems for electric drives are complex production facilities of the cybernetic type, all elements of which are involved in a single production process, the main specific features of which are the transience of phenomena and the inevitability of damage of an emergency nature. Therefore, reliable, optimal and selective construction of a mathematical model of electric drives of industrial enterprises is possible only with automatic control [1]. For this purpose, mathematical modeling of electric drives in the electric power industry is used.

MATERIALS AND METHODS

To build a mathematical model of electric drives, we used the MATLAB Simulink program. The issues of design and modeling of asynchronous electric motors remain very acute, since the requirements for the performance of modern electric motors have increased significantly. To solve such problems, computer-aided design systems are often used.

However, most of the models created in them are not interactive [2].In this regard, the use of the latest software products, in particular, the software module in the Simulink environment of the Matlab program, is of considerable interest. This software module is a modern tool for designing and modeling various types of electrical machines.

RESULT AND DISCUSSION

This article is devoted to the construction of a mathematical model of electric drives of hydroelectric stations and operating modes of a gas turbine drive in the Simulink environment of the Matlab program. For laboratory analysis, the results were taken of constructing a mathematical model of hydraulic engineering installations, and all aspects of the electric drive were considered.

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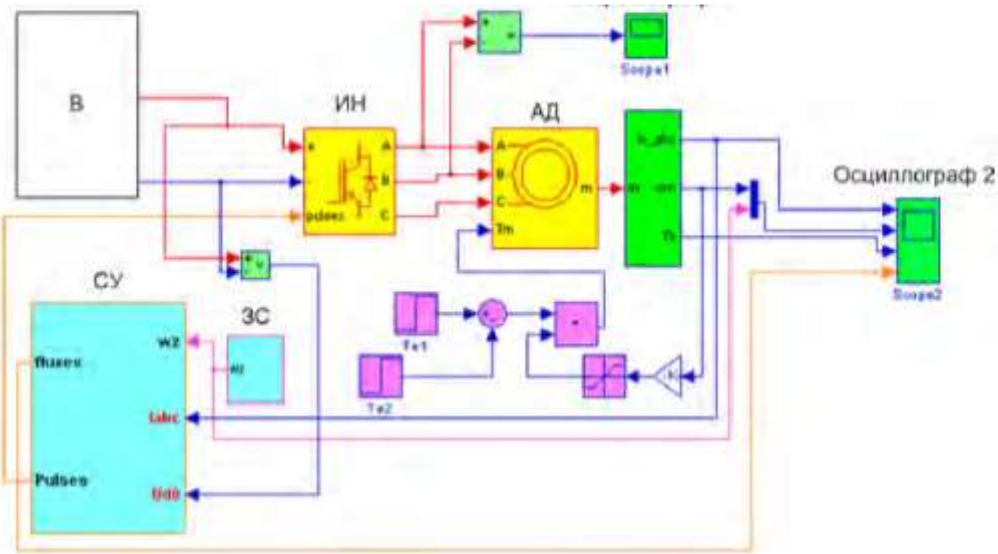

Fig.1. Mathematical model of the drive in the Simulink environment of the Matlab program.

B - Voltage rectifier (active rectifier, in the case of an excavator or a diode multiples rectifier, in the case of a dump truck); IN - voltage inverter; HELL - asynchronous motor; SU-control system of the electric drive.

In the mathematical description of the simulated engine, the following assumptions were made:

- There are no losses in steel;
- Phase windings are shifted by 120 °;
- Constant value of the air gap;
- The real distributed winding is replaced by an equivalent concentrated one, creating the same magneto motive force;
- The machine has a symmetrical rotor;
- Magnetic fields and magneto motive forces of the windings are distributed along the circumference of the air gap according to a sinusoidal law.

The mathematical model of an asynchronous electric motor is described by a classical system of fifth-order differential equations:

$$U_{s1} = \frac{d\psi_{s1}}{dt} - \psi_{s2}\omega_k + R_s I_{s1}$$

$$U_{s2} = \frac{d\psi_{s2}}{dt} - \psi_{s1}\omega_k + R_s I_{s2}$$

$$0 = \frac{d\psi_{r1}}{dt} - (\omega_k - p\omega)\psi_{r2} + R_r I_{r1}$$

$$0 = \frac{d\psi_{r2}}{dt} - (\omega_k - p\omega)\psi_{r1} + R_r I_{r1}$$

$$M_d = \frac{mp}{2}\left|\dot{\psi}_s \times \dot{i}_s\right|,$$

The control system structure (Figure 2) contains a speed controller, a coordinate calculation unit, and DTC implementation blocks.

The control system includes a speed controller, a coordinate calculation unit, DTC, implementation blocks. Digital speed controller PI - type with parameters $K_п$ = 2000, $K_и$ = 10000. The width of the hysteresis loop of the flow controller is ± 0.02. The width of the hysteresis loop of the torque regulator is ± 30. In the S - "DTC" function, based on the sector number and the combination of signals of the relay controllers, the address of the voltage vector selection is formed. At the received address, a number corresponding to the required key position is extracted from the array [5].

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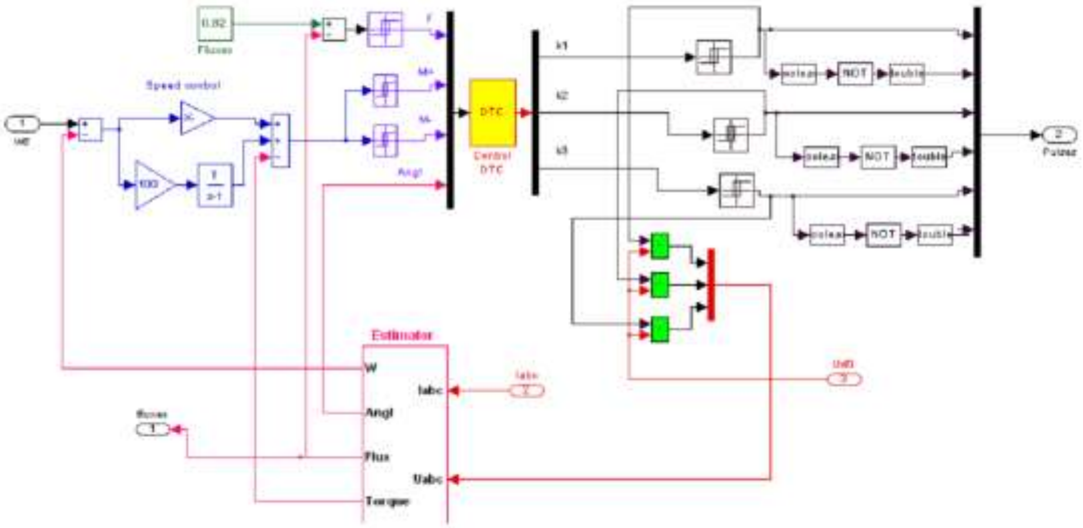

Fig.2.Control system model diagram.

The control system includes a block for calculating coordinates of an incomplete order. The coordinates are determined by the measured motor currents and the selected voltage vector. In the block, the projections on the fixed axes of the stator winding flux linkage vector and its module, the projections on the fixed axes of the stator winding flux link vector, the rotational speed of the rotor flux link vector, the rotation speed of the motor shaft, the angular position of the rotor flux link vector, and the electromagnetic moment are calculated.

In well-known DTC schemes, the sector number is determined by the angular position of the stator flux linkage vector without taking into account the position of the rotor flux link vector. The location of these vectors in different sectors leads to increased pulsations of the moment. The simulation results showed that the sector is better determined by the rotor flux linkage vector.

The control system with DTC provides fast, direct control of the torque and maintaining the stator flux linkage at a given level in asynchronous machines. The system must necessarily contain a unit for calculating the coordinates of the drive. In this case, the spatial stress vector is directly calculated based on the mismatch in the moment and flux linkage without the use of customizable regulators. The only adjustable controller is the speed controller. Setting the relay controllers consists in setting the desired switching frequency of the inverter keys.

The mathematical model was tuned in the first case - according to the data of the excavator stroke engines. According to the results of studies on a mathematical model, diagrams of the operation of electric drives with an asynchronous motor, stroke and lift motors of the excavator in dynamic drive operation modes were obtained. Modeling was carried out under the maximum load.

To increase the performance of hydro technological complexes, it is advisable to switch to the use of a non-contact asynchronous electric drive with a frequency converter due to the simplicity of its maintenance and ensuring the necessary operating modes of the main drives.

CONCLUSION

The system performance at rated load corresponds to the declared values, and the mismatch between the speed reference and the actual speed is no more than 5%, which indicates the possibility of using relay-pulse control algorithms using the laws of direct control of the torque of an asynchronous motor as part of the control systems of hydraulic systems.

The construction of a mathematical model of the electric drive will give us a huge advantage for monitoring and controlling GTU electric drives and the use of pulse-relay control algorithms when generating the motor supply voltage provides a higher speed compared to vector control algorithms, limits torque overshoot and thereby reduces dynamic loads.

REFERENCES

1. *Zaripov, Sh., Sa'dullaev, M., Sa'dullaev, T., & Sa'dullaev, O. (2017). Razrabotka ratsionalnыxresheniy beskontaktnogo upravleniya elektroprivodami gornыx mashin. Sovremennыe nauchnыe issledovaniya i razrabotki, (8), 201-205.*
2. *Sa'dullaev, M. S.,Xamzaev, A. A., Narzullaev, B.SH.& Sa'dullaev, T.M. (2018) Ispolzovanie ustroystv, sostoyaщix iz beskontaktnыx elementov, v upravlenii kompensiruyuщimi ustroystvami. Molodoy uchenыy, (1), 23-25.*