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“Sterowanie i synchronizacja serwozaworów hydraulicznych do zastosowań w lotniczym siłowniku tandemowym wykonanym w technologii DMLS”

Summary

The aim of the work was to develop a control system which ensures synchronous operation of two servo valves with the use of a four-channel three-phase motor with permanent magnets for use in a tandem actuator, for small and medium-sized aircraft. The paper presents an overview of hydraulic valves and servo valves, types, construction, technical parameters and differences between them. The design of the tandem actuator with a double servo valve, made in the Yasa company by 3D printing from steel powder, was shown and discussed.

Due to the technological problem of matching the edges of the double rotary spool in the first version of the servo valve of the tandem actuator, the double spool was replaced with two servo valves manufactured in the company. A simulation model of a four-channel three-phase motor with permanent magnets was made. Tests were carried out to assess the compatibility of the model and the real prototype. The ways of controlling the windings of a three-phase motor, their advantages and disadvantages are presented. A simplified model of the directional control valve was made. The simulation results using the proposed model (four-channel three-phase motor with a power supply system and a hydraulic control valve) were compared with the tested real prototype. Based on the analysis of the available literature review, a regulator controlling the position of the servo valve spool was proposed. Simulations and tests on the real prototype of the servo valve met the quality requirements. In the next step, a regulator synchronizing the operation of two servo valves was developed. Simulation tests, during which one of the servo valve spool jammed was also simulated, confirming the effectiveness of servo valve control synchronization, and the requirements for control quality were met. The obtained results confirmed the possibility of using two servo valves with four-channel three-phase motors in the tandem actuator solution with the use of a synchronizing regulator. The proposed solution will allow to reduce production costs while maintaining product quality.