Research of the aircraft dual-mode actuator with combined speed control during the transition from the main type of power supply to the backup

A S Alekseenkov and V S Stepanov
Moscow Aviation Institute
(National Research University)

2019
Schematic diagram of dual-mode electro-hydraulic actuators with combined speed control (EBHA-CSC)

LEM – linear electric motor,
M – DC brushless motor,
MSV – Mode selection valve,
RV – Reversing valve,
EHSV - Electrohydraulic servovalve,
AFCV – spool of EHSV,
EHA – Electro-hydrostatic actuator.
The object of study, research methods and main results

When dual-mode electro-hydraulic actuator with combined speed control operates from an external hydraulic system, it works as a typical electro-hydraulic servovalve actuator. The principal task in the compilation of the mathematical model was the correct description of the electro-hydraulic valve which switches actuator active modes. To study the switching modes of EBHA-CSC a highly detailed mathematical model was developed in MatLab Simulink.

The mathematical model of actuator, that was taken as a basis, is described in «Improving the dynamic properties and the study of the working processes of the aviation hydraulic actuator with a combined speed control with increasing external load», A S Alekseenkov, Moscow, 2014
In the mathematical model of mode selection valve (MSV) the following issues were considered:

- the position of the valve and the opening area of the spool ports were depended on the pressure under the edge of the spool and the spring compression force;
- the inclusion of the mechatronic actuator module was carried out simultaneously with the command to pilot valve, i.e. the electrical energy channel was in the «cold reserve».
- idle actuator was considered
Experimental data:

When the actuator transits from the main to autonomous mode of operation, there is a drop in the speed of movement of the actuator stem related to the output of the mechatronic module and the pump to the nominal mode of operation from the «cold reserve».

During the reverse switching of the energy channels, an uncontrolled jump of the output link of the actuator is observed, caused by the operation of the valve.
Conclusions

The obtained experimental graphs correspond to the results of mathematical modelling, which allows us to speak about the reliability of the accepted research methods. The developed mathematical model is well verified with the previously obtained results, which allows it to be used to study various modes of operation of dual-mode electro-hydraulic actuators with combined speed control.

In addition, the developed mathematical model can be used in the educational process to train specialists in the field of actuators for ground, aviation and space technology.