

PhD thesis abstract

Modeling and testing of an electro-hydraulic actuator for aerospace applications made in the DMLS additive technology

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Abstract:

The doctoral thesis deals with the possibility of applying the so-called 3D printing for the construction of complex hydraulic systems used in a Fly-By-Wire control system on the example of a servo actuator made in DMLS/SLM technology. Thanks to the use of additive technologies, it was possible to make internal flow channels with variable cross-sectional areas and to place two control servo valves in a central housing between the piston rods with an unprecedented level of integration. In the thesis, strength tests were carried out on steel 1.2709 after laser melting used for the manufacturing of the actuator. Among others, the following were performed: static tensile test, tension fatigue tests and pressure fatigue tests.

The doctoral thesis also deals with the development of a mathematical model of a servo actuator in a tandem configuration, taking into account complete internal redundancy of electrical, mechanical and hydraulic systems. As part of this task, the following were performed: analysis of the forces acting on the spool mechanism of the control valve, analysis of the fluid flow through the control valve, mathematical model of the spool's direct drive (motor) and analysis of the forces acting on the piston rods of the actuator. Moreover, in order to verify the proposed mathematical models, experimental tests were carried out on a real prototype, determining the main static and dynamic characteristics for the control servo valve and the actuator.