Next-generation more electric aircraft control system

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Abstract:

One of the areas of changing the aircraft into the electric direction is the diminishing energy needed for the aircraft's automatic flight control. Therefore, there is a possibility of controlling their flight in automatic mode or stabilising their flight with trimmers for some of the aircraft types.

Previous research on the cost-effective and less electrical energy consuming automatic stabilisation system for an aircraft resulted in constructing a laboratory model of the system. Such features are beneficial in initiatives like Future Sky, electric aircraft and aircraft stabilisation system retrofit. The system was developed using Model-Based Design, tuned and tested in Model, Pilot and Hardware in the Loop Simulations. The implementation of this system does not modify the pilot's primary manual controls. Instead, the electrical trim system is used for automatic stabilisation or manual trimming, depending on the chosen operation mode.

The paper presents the development process of the laboratory model of the system and the results of its simulation and flight tests. Computational unit software was prepared for porting automatically generated code from the Simulink model containing system state machine and control model previously tested in simulations including Model, Pilot and Hardware in the Loop. Hardware was prepared and tested to meet DO-160G environmental and electrical conditions and restricted electromagnetic compatibility tests. After Hardware in the Loop laboratory tests, onboard computer flight tests were performed

The flight tests were planned according to civil aviation authority and aviation law requirements. Results from series of flights were analysed and presented. Tuning of the stabilisation system gains and other parameters was conducted in flight. A unique application was developed to allow the operator inside the aircraft to change stabilisation system parameters on a touchscreen tablet during the flight. Logged aircraft parameters were compared with previous Hardware in the Loop real-time simulated flights.

The goal of the stabilisation system flight test campaign was a verification of its performance on a real aircraft. In addition, pilot feedback about aircraft handling qualities was gathered. Comparison of real and simulated data allowed identification of aircraft model deficiencies and implementation of improvements.

Keywords: flight tests, automatic flight stabilisation system, trim tab, trim system

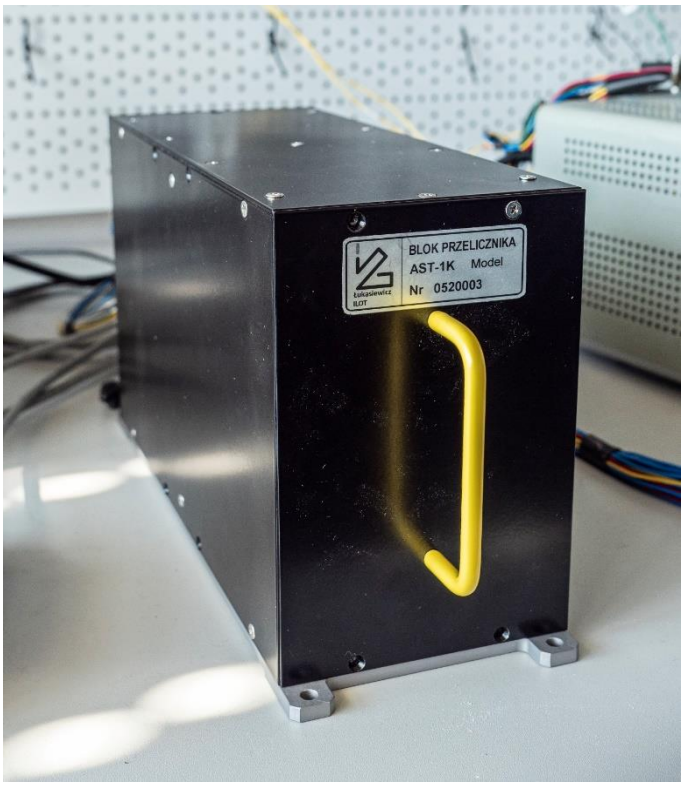

Figure 1. Laboratory model of automatic stabilisation system onboard computational unit.