DEVELOPMENT OF SARAS AUTOPILOT

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Abstract

The Automatic Flight Control System (AFCS) for the SARAS aircraft is being designed in collaboration with a private partner. The AFCS provides for Flight Director Guidance function involving a three axis limited authority autopilot with pitch auto trim function. It features CAT II approach capability and Control Wheel Steering (CWS). The architecture is fail-safe and extendable to a dual-dual configuration. The autopilot actuators are all electric smart brushless DC motors which engage with the all-mechanical reversible Primary Flight Control System in parallel via individual geared clutches.

The Control Law (CLAW) for the autopilot has been designed in NAL based on the aerodynamic data provided by the SARAS project. The CLAW is based on inner loops that provide damping augmentation in pitch and roll and also yaw damper function while ensuring desired closed loop performance. The inner loops also function as basic modes of the autopilot. The outer loops provide higher modes in the vertical (Altitude Hold, Altitude pre-select, Speed Hold, Vertical Speed Hold) and lateral (Heading Hold, Heading select) axes. In addition to these modes, the autopilot will provide for radio modes like VOR Hold and Approach modes (Localiser and Glideslope Capture and Hold). They are designed to convert the outer loop tracking error into equivalent pitch and roll attitude commands for the inner loops. Comprehensive Mode Transition Logic (MTL) determines the transfer between compatible modes of the autopilot. MTL minimizes the transients during Autopilot engagement, mode transition and Autopilot disengagement.

To achieve its functionality, the AFCS interfaces with the federated avionics architecture of SARAS. The main pilot vehicle interface for the AFCS is the Autopilot Control and Mode Select Panel (ACMSP). ACMSP consists of buttons for engagement / disengagement of autopilot, selection of autopilot modes and annunciators for indicating the selected mode apart from other functions of the autopilot. The Primary Flight Display for the AFCS is the Electronic

Flight Instrumentation System (EFIS). The EFIS displays the Flight Director Guidance Bars and also the current state of the autopilot including the active and armed modes. In addition to these, the AFCS interfaces with the Quick Disconnect switch, SYNC switch (used for CWS) and the Manual Electric switch mounted on the pilot and co-pilot control yokes.

The AFCS will be implemented on hardware provided by the private partner, which is qualified to DO-160D standards. The AFCS provides interfaces for integration of additional systems like Flight Management System in future. The software will be developed by the private partner based on DO-178B level A standards. The private partner is also responsible to provide the Engineering Test Station (ETS) for conducting the software-integration, hardware-software integration and system testing as per the system requirements. The responsibility for Independent Verification and Validation of the AFCS rests with NAL.

Independent experts have reviewed the Autopilot Control laws. At the present time, the Preliminary and Critical Design Reviews of the Autopilot System has been completed successfully.

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