

Model-Based Autopilot for UAV Systems

From model to flight

AVIADYNAMICS LLC

Introduction

Modern unmanned aerial systems require a high degree of integration between control, navigation, and diagnostic algorithms. The model-based approach enables the design, testing, and certification of such systems using digital twins and automatic code generation tools.

Autopilot Architecture

The autopilot is based on a modular design and includes FSW, FCS, NAV, MIXER, and STATE MACHINE components. Each module has traceable interfaces (ICD) and parameters defined in a Data Dictionary, ensuring a seamless transition from model to executable code.

Model-Based Design

Model-Based Design (MBD) provides a complete cycle of system design and verification. MATLAB/Simulink tools allow simulation of flight dynamics, tuning of control algorithms, and automatic generation of certifiable source code.

DO-Certifiable Code Generation

Automatic code generation tools (ERT, MISRA) are integrated into DO-178C and DO-254 compliant workflows. Requirement traceability, automated test coverage (QTG), static analysis, and code review ensure certification readiness.

Domestic Stack and Scalability

The architecture supports deployment on various platforms, including PX4, ArduPilot, and proprietary systems. Advanced domestic tools ensure independence and flexibility in integration.

Practical Implementation

The model-based methodology in AVIADYNAMICS autopilots involves developing a digital twin of the aircraft, simulating control systems, and automatically validating models in MIL, SIL, and HIL environments. This allows evaluating stability, dynamics, and response without costly real-world tests, providing 95% correlation with flight data and reducing development time by 40%.

Integration with Certification Processes

The development methodology complies with DO-178C, DO-254, and Russian R-331 standards. It includes requirement traceability, automated verification of code coverage, and generation of reports for certification authorities. The platform supports QTG exports and automated documentation for audits and certification procedures.

AVIADYNAMICS Platform Development

The platform is evolving into a universal solution for integrating control systems for multicopters, fixed-wing, and VTOL UAVs. It supports code generation for Visual Studio, GCC, and Keil environments, works with RTOS and embedded systems, and includes tools for automatic model analysis and PID optimization. Interfaces are compatible with PX4, ArduPilot, and domestic UAV projects.

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