Aircraft and Flight Management Systems (FMS)

Solution overview: Automated testing of aircraft and flight management systems through the Graphical User Interface, GUI.
Solution overview: FMS

A brief description of the modern “fly by wire” software based aircraft and the philosophy of operation is as follows:

The modern aircraft that is currently in production is basically a sophisticated, integrated computer vehicle with wings. These aircrafts are designed to be flown in the full auto-flight mode with the pilot or operator acting as a monitor of the system while in this full auto-flight mode. The pilot has dedicated controls, such as autopilot, auto-throttle, guidance panel etc. for use when the functions required are frequent; as in a direct independent access or a need to interrupt a task. All other non-quick access functions are managed through the Graphical User Interface, or GUI with support from a cursor control device, alpha numeric keyboard panel, control data unit etc.

The systems displays in the modern aircraft, the Multiple Display Units (MDU) or pilot display units (PDU), show all flight information such as communication, navigation or flight management as well as system status and electronic checklists. These displays are usually 14 inch digital display units.

The Flight Management System, FMS, architecture can be considered as a single integrated navigation system that is supported by the three FMS functions while operating in a single or synchronized manner. Most aircraft have multiple FMS with the same capability, but it is common to have a dedicated master FMS and its selection is dependent on the aircraft type and mode of selection. The master FMS receives pilot input through the GUI or the keyboard. The master FMS feeds the other FMS and systems operate in a synchronized mode with a continuous system crosscheck.

The FMS functions include:

- Position computation
- Speed management
- Performance Prediction
- Lateral navigation (LNAV)
- Vertical navigation (VNAV)
- Flight plan management

The FMS system will use various systems to compute position and calculate performance data.
The operation of a modern aircraft with a full auto-flight mode through a fully integrated FMS must be completely tested prior and during each flight. The pilot must be able to verify each and every input to the FMS system, whether that information is downloaded from a database or an input by the pilot. Through the GUI and various mouse and keyboard strokes, the pilot is able to completely access all systems and functions critical to the safe operation of the aircraft. The testing of the various functions of the auto-flight systems can be done as an individual system or as an entire integrated system.

The MDU’s, display all preflight aircraft system tests required either by the system self test or the tests initiated by the pilots through the GUI. Any input into the aircraft’s system which is necessary for the operation of flight is displayed and verified through the various displays. The FMS is a most critical component of the entire auto-flight system since it is responsible for performance, navigation and integration of all components of the auto-flight system. The actions of non graphic actions by the pilot will also have a result that will be displayed and verified on the monitors. This could be any action via an on/off switch or mouse and keyboard stroke.

The major point to be emphasized, in an aviation environment, is that there must always be a situational awareness and that the integrated flight systems are to enhance and thus contribute to the safe operation of the aircraft. The challenge is to ensure that all system displays are verified and displaying the correct results from the various inputs thus performing a safe flight.

During the aircraft systems and software engineering life cycle, specifically during the integration, verification and validation, and system test phases, each global pre-flight, take-off, en-route, approach, and landing scenario must be tested with as many keyboard, mouse, and switch combinations as possible. In order to ensure a working and accurate FMS system, there can be thousands of potential world-wide flight scenarios, each requiring performance tests, contingency situations, erroneous inputs, system crash prevention testing, as well as the capability testing of the FMS system. Manual testing of these all-encompassing scenarios in order to properly validate and verify the FMS system for safety critical requirements compliance is vast. An automated testing solution with eggplant can be utilized to achieve these objectives.
The Solution

Automated testing with eggPlant is very simple. It’s a GUI software and system testing tool that has the ability to perform robotic test routines through use of image recognition technology. eggPlant “sees” the screen in exactly the same way a human eye would and thus has the ability to interact with any HMI or technology. Furthermore, the eggPlant architecture is very unique (as recognized by its US patent) since it connects to the System Under Test (SUT) through a remote technology called VNC. This two-system approach ensures no unnecessary or “foreign” software is installed on the target system.

eggplant, through user pre-defined scripts and suites, carries out a comprehensive set of system level functions and capabilities verifying and validating database generation, update, and use; all functions of the FMS components, and the MDU/PDU display units. Its capabilities are used to predefined, plan and automate system integration testing, providing test repeatability during regression testing and other major phases of the testing cycle.

Following the execution of tests, eggPlant delivers coordinated test reports and analysis aids that are used to verify the complete system or application against the predefined requirements and interface specifications. These results are often supplied as part of a deliverable for the project.

eggPlant - using its unique image recognition technology is able to detect bugs and assisted the team in resolve key issues. This adoption of automated test technology results in improved system quality, reduced delivery times and lowered costs when compared with an exclusively manual testing regime.

The aircraft are considered visual aircraft since all necessary data is displayed on a screen and verified by the pilot. All inputs, in all phases of flight, require a visual verification so every click of the mouse, every button pushed, every on/off switch has to be verified on a display screen.

The automated testing solution via the utilization of eggplant can efficiently and comprehensively test FMS on-board aircraft systems during the engineering test and system integration life cycles. Scripting multiple test suites for many scenarios of operator and user inputs allows for the automatic and comprehensive tests of the FMS capabilities in all flight modes and all flight profiles. During the test executions, MDU and PDU resultant displays are saved at the local or remote eggplant system for subsequent test/display verification, test reporting, and test analysis.

Example

About TestPlant
TestPlant is the developer of eggPlant, the leading image based test automation tool. eggPlant tests any system, validates any platform, and automates any process.

Visit www.testplant.com
E-mail sales@testplant.com
US Tel: + 1 720-890-0211
UK Tel: +44 20 7002 7888