Creare Inc.
P.O. Box 71
Hanover, NH 03755
www.creare.com
Point of Contact:
Dietz, Anthony
603-643-3800
ajd@creare.com

Title

Flight Test Assistant

SBIR Topic Number

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Summary Report Type

Phase I Summary

Summation

The objective of this project is to increase the efficiency and decrease the cost of flight test operations by providing the test pilot with a portable in-cockpit Flight Test Assistant (FTA). Flight test programs are typically conducted with a limited budget and within a tight schedule, making test efficiency an important program goal. However, the cost to fully instrument an aircraft for a flight test program can be prohibitive. To date, the only alternative to expensive instrumentation has been classical test techniques involving a stop watch and hand recording of data from the aircraft instruments.

The advent of portable GPS receivers, micro-electro-mechanical (MEMS) inertial sensors, and highly capable pocket computers has opened the window for a new and innovative approach to aircraft flight testing. All but the most demanding flight test data requirements can be met by a system that can be carried out to the aircraft in the test pilot's pockets, installed during the pre-flight inspection, and calibrated while transiting to the test range. Creare's FTA makes this scenario possible.

Off-the-shelf sensors, dynamic calibration routines, and innovative estimation algorithms are combined in the FTA to provide accurate test results. Supplementary data entry and instrument control are managed through a robust, speaker-adaptive, speech recognition engine that remains reliable at challenging cockpit noise levels. An object-oriented graphical programming environment facilitates pre-flight system configuration with a minimal learning curve. In flight, an intuitive display interface provides feedback on test execution and test point quality.

The FTA reduces the time and cost for flight test operations by: (1) reducing the need for custom aircraft instrumentation modifications, (2) reducing test pilot workload, (3) providing in-flight feedback on test technique and test results, and (4) enabling background acquisition of test data. The FTA system may also be used for other functions, such as a navigation display with a moving map showing location within the test range, or as a backup attitude indicator in case of instrument failure. We believe that the power and flexibility of this instrument will also make it valuable in pilot training and flight operations quality assurance applications.

In Phase I of the project, we proved the feasibility of our FTA concept by demonstrating key technologies in a rapid prototype FTA system. We implemented a graphical programming environment coupled to a flexible display interface that could be configured to provide useful feedback during typical flight test sorties. The prototype system includes a voice interface for data entry and system control. We then evaluated the performance of the prototype during simulated flight test sorties. Additional tests of the speech recognition engine in simulated F-16 cockpit noise confirmed accurate voice recognition in noise levels up to 103 dBA. Analysis of data from flight tests with the proposed sensor package confirmed the ability of a dynamically calibrated atmospheric model to generate accurate estimates of air data from GPS position data.

Creare's FTA offers an innovative approach to aircraft flight testing. The ability to generate test data of a reasonable quality using inexpensive sensors carried aboard by the test pilot opens up a whole new range of test possibilities. Furthermore, the voice interface will reduce the test pilot's workload, while the modeling and estimation capabilities and the in-flight display of test results will improve test technique and increase test productivity.

Anticipated Benefits

Creare's Flight Test Assistant offers many benefits over classical techniques for testing un-instrumented aircraft. For certain test tasks, the FTA also has significant advantages over standard test

instrumentation:
• Data Collection. Data from portable pilot-installed sensors can approach the quality of flight test instrumentation in certain applications without expensive aircraft modifications.
• Data Estimation. Dynamic calibration of environment, aircraft, and system models coupled with advanced estimation algorithms extends the number of test parameters that can be derived from the pilot-installed sensors.
• Facilitates Pre-Flight Test Preparation. The FTA is designed to assist the test pilot in all phases of the test process. An intuitive graphical programming environment enables easy configuration of sensor data acquisition and data reduction routines before the flight. Automated uncertainty analysis reports the accuracy level that can be expected from the system for each particular test configuration.
• In-Flight Feedback. Real-time analysis of test data and in-flight display of the data and the test results are large advantages over classical techniques and over standard test instrumentation where data may be telemetered to the ground but not be available to the pilot. In-flight feedback on test results and flight test techniques will improve the quality of the test data obtained in any given flight.
• Reduced Workload. The use of a voice interface for instrument control and supplemental data entry will significantly reduce the test pilot's workload.
• Increased Productivity. Background algorithms collecting data for future test points on an opportunistic basis will increase the number of test points that can be flown in any mission.

With these benefits, the FTA should prove to be a valuable addition to test pilot schools and flight test centers. It should also prove attractive to users in the commercial and general aviation industry and particularly to experimental class aircraft owners and builders interested in measuring the performance and flying qualities of their aircraft. The system may also find a place in pilot training where post-flight review of aircraft trajectories would aid the learning process. Finally, the system could be useful in the new Military Flight Operations Quality Assurance initiative, where in-flight data are to be used to analyze pilot and aircraft performance with a view to improving operations, training, and safety.
