A Wing Deployment Test System to Ensure Missile System Readiness

By

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Category: Aerospace/Defense

Products Used
LabVIEW 7.1
LabVIEW State Diagram Toolkit
PCI-6040 Multifunction Data Acquisition
SCB-68 – Shielded I/O connection block for DAQ

The Challenge
Develop a system to characterize the deployment of a wing assemblies for military missiles. The system needed to have the flexibility of adding new wing assembly types to the user selector, as needed. A report file was required to contain all of the data acquired and all of the information displayed on the front panel. A configuration file was required to allow the operator to change the names of the Air Foil Group Types that populated the list available to the operator or a selector.
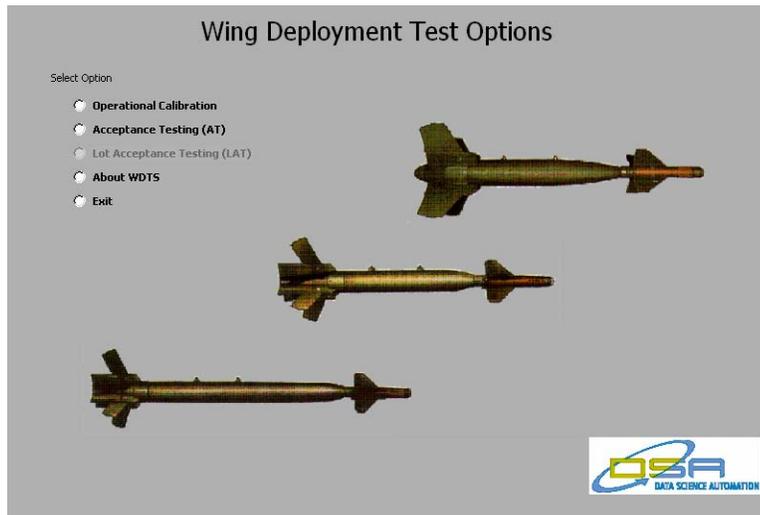

Figure 1. Main Startup Screen

The Solution
The solution required the implementation of a system, calibration process. and recording of the operator and the date of calibration. The system is normally calibrated once at the beginning of each day. The system was required to acquire the wing release force and the wing deployment angle as a function of time. The maximum

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release force occurred at the point of wing deployment and was compared to a tolerance. Once deployment was initiated, the time required for full deployment was determined and compared to a tolerance.

Abstract
During storage of missile systems, various aspects of their readiness can sometimes degrade over time – sometimes resulting in launch failures or inaccurate targeting. One of the primary failure mechanisms is due to degradation of the wing deployment subsystem. The development of an efficient method to characterize the readiness of the wing deployment subsystems for a broad range of missile systems allowed their readiness to be validated and prevents operational failures in the field.

Introduction
Data Science Automation, Inc. (DSA) used National Instruments (NI) LabVIEW software to create the application (Figure 1). DSA utilized the LabVIEW State Diagram Toolkit to quickly create the main state machine architecture. The LabVIEW State Diagram Toolkit makes handling the evolving requirements easy by providing a way that allows the developer to easily visualize and modify the state transition flow.
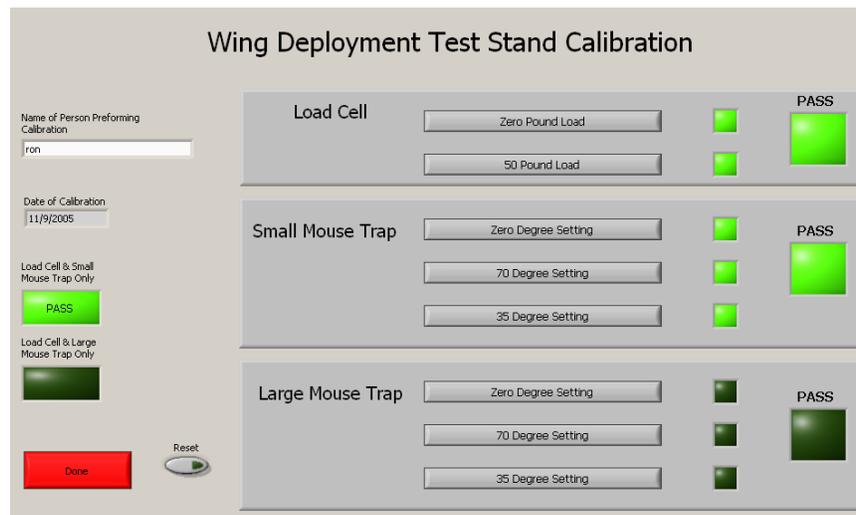
Figure 2. Calibration Screen

The calibration (Figure 2) procedure determines "degree per volt" and "pounds per volt scaling of the load cell and angular encoder. This calibration is performed by the operator by first entering their name then pressing the "Zero Pound Load" button with no load on the transducer, then placing 50 pounds of force on the cell and pressing the "50 Pound Load "button. The operator then must chose which "mousetrap" deployment fixture will be used for the test and connect it to the SCB-68 connector block. Once the mousetrap is connected the operator will set the wing angle to zero and press the "Zero Degree Setting" button. The operator will then move the wing angle to 70 degrees and press the "70 Degree Setting" button. Finally the operator will set the wing angle to 35 degrees and press the "35 Degree Setting" button to have the application calculate the mid point from the 0 and 70 degree reading and verify that the 35 degree reading is within the specified parameters. An event structure was implemented to support the user interface making it easer to determine the state selection.

The start of the data acquisition for the wing deployment test stand uses a software trigger controlled by the operator. Test data acquired is only allowed to commence if the following conditions are met: a calibration had been performed with a passing result, the operator entered their name, the air foil serial number was entered, and the air foil group type had been selected. When the "Start Data Collection" was pressed the operator would be informed by the "Awaiting Pull Latch" LED on the front panel that they could manually pull the latch to initiate the

deployment test. The Angle / Pull Force chart is updated as the test progresses (Figure3). The Static Deployment Times indicators would illuminate as the wing passed the corresponding angle. The "Operator Message" indicator box at the top of the screen will provide status/diagnostic information to the operator about the test if the tolerances had not been achieved. Once the operator had completed the test the option to save the acquired data and a screen shot of the front panel could be selected by pressing the "Save Data" button. The screen shot (Figure 3.) was generated using "Write JPEG File vi" provided in the LabVIEW Graphics and Sound palette.

Data Science Automation, Inc. was able to reconstruct the test application using National Instruments LabVIEW software in a timely and cost effective manner for our client. The end result was a flexible application that could be modified to make adjustments for newer models of air foils.
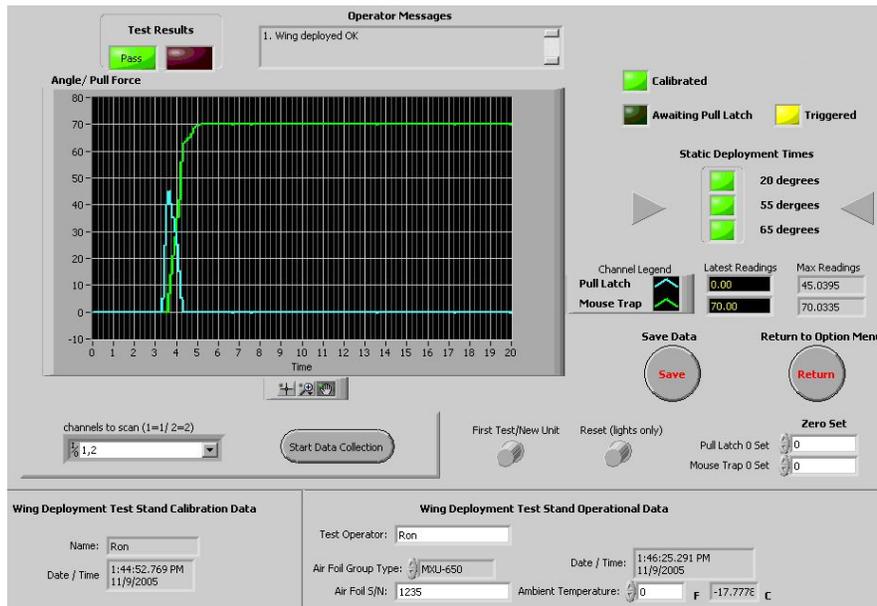

Figure 3. Data Acquisition Display