Design and Development of an Actuation and Extraction Force Tester For Switch Assemblies: Programming

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Abstract

The software development team responsible for the Applied Avionics, Inc. (AAI) senior design project has been tasked with integrating electrical and pneumatic components in order to deliver a machine capable of performing client-specified tests on pushbutton cockpit switch assemblies. The project requires utilization of LabVIEW in conjunction with hardware to capture and display force and position data, automate routine testing processes, and facilitate communication with AAI's internal database. The produced machine, capable of performing automated actuation and extraction verification tests, is intended for use by AAI to ensure quality standards are met and to perform one-off tests on a variety of switch body types, while mitigating sources of variability present in AAI's current testing processes.

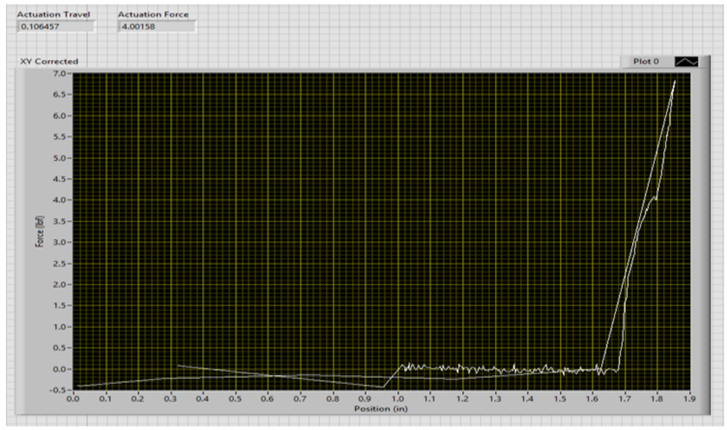

Figure 1: Actuation Force versus Travel Sample Data

Figure 2: Final Machine
(Covers Removed to Show Internal Components)

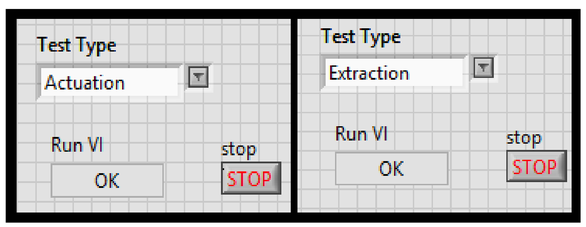

Figure 3: Test Type Selection User Interface

Applied Avionics, Inc. is a Fort Worth-based manufacturer of cockpit switches, distributed for use in military and commercial applications. To meet government-specified safety requirements, three tests must be performed in order to obtain actuation force, actuation travel, and extraction force characteristics for newly-produced switch assemblies. This project's primary goal is to design and build a LabVIEW-controlled machine which performs these three tests in a manner more efficient than the current system.

Objectives

The manual actuation and extraction force testing machine currently used at Applied Avionics, Inc. should be improved upon in three key areas. Firstly, variability, introduced by the machine operator's need to listen for switch actuation clicks during data acquisition, should be reduced, diminishing the need to re-run completed tests. Secondly, the current system requires the three pertinent tests be run separately; utilizing the newly developed machine, all relevant switch information should be obtained through one uninterrupted test, unless otherwise specified by the machine's operator. Lastly, actuator, gripper, pneumatic system, and laser sensor control and feedback must be interfaced using LabVIEW software in order to automate the testing sequence.

Testing and Conclusion

The developed machine has undergone trials at TCU, where calibration weights and previously tested assemblies have been used to ensure that the machine yields accurate results, within the precision limits specified by AAI. To ensure obtained actuation test results were correct and consistent, points at which the actuator made initial contact with switch caps during actuation tests were recorded; following these initial contacts, increases in force were observed. Reductions in force, corresponding to actuation ("clicking") followed, at which points force and position data were recorded and compared with known results. Because the required extraction test only specifies a desired force, the machine's performance during extraction was verified by determining the maximum force experienced during extraction for a variety of switch cap samples. For safety, software limits and optical sensors were employed to avoid damaging switches and prevent the potential for operator injury during the testing cycle. Moving forward, the assembled machine will undergo further testing before its delivery to the Applied Avionics, Inc. facility, where it is expected to be utilized for the foreseeable future and serve as a model for a second machine.