

LabVIEW Real-Time Reduces Development Time of Hydraulic Actuator Test Cells

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The Challenge: Reducing the cost and development time of test consoles for different hydraulic flight controls used in commercial and military aircraft.

The Solution: Replacing custom electronic consoles with a reusable, flexible platform built from commercial off-the-shelf tools.

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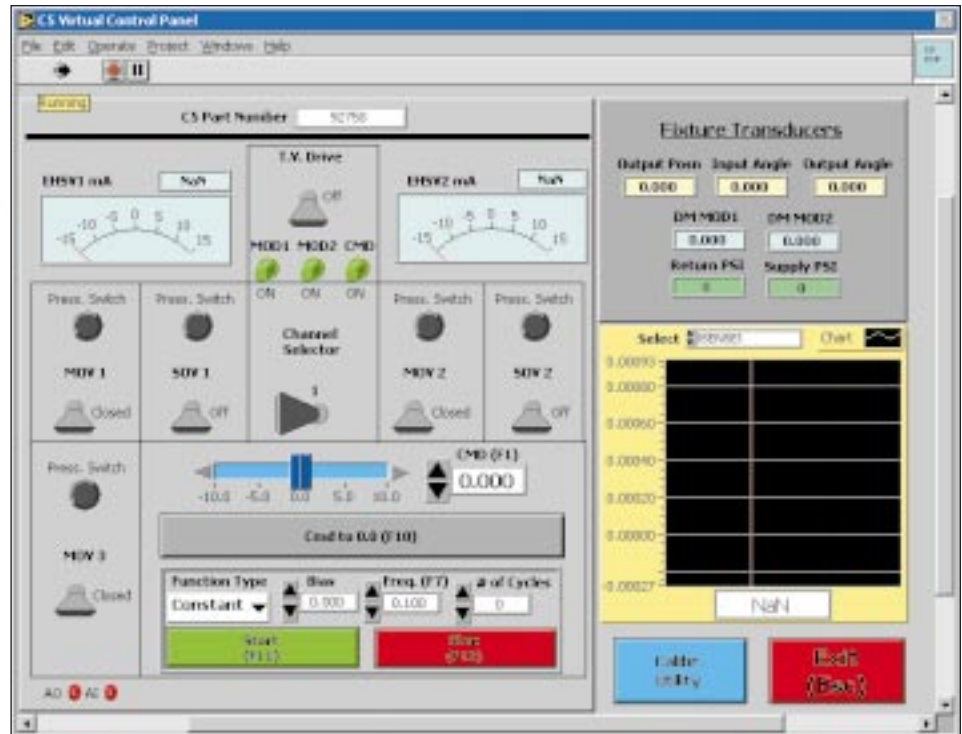
Parker Hannifin Corporation, a leading diversified manufacturer of flight control systems and utility hydraulics, plays a major role in the aerospace industry. Resources from the Parker Hannifin Corporation and the Parker Aerospace Group help the Control Systems Division-Military (CSD-M) Commercial (CSD-C) offer technological innovation and experience, advanced manufacturing capabilities, and product support. CSD-M products feature a broad variety of essential technologies, including hydro-mechanical, fly-by-wire, power-by-wire, electromechanical, and electro-hydrostatic actuation with a variety of hydro-mechanical products that require testing.

With National Instruments LabVIEW Real-Time and PXI, we can efficiently develop new test consoles within weeks as opposed to months.

Flexible Test Consoles

Testing new hydraulic products requires the design and fabrication of custom electronics, which are both costly and time consuming. These test consoles require a significant amount of new design, while the maintenance and calibration of these unique consoles is a burden on resources.

The flight controls we test are manufactured in various sizes and perform different functions, depending on their



Virtual Control Panel Created with LabVIEW Real-Time

position in the aircraft. For example, we test hydraulic actuators that move various parts – such as the rudder, elevator, aileron, and other surfaces – on the aircraft. Each console performs tests that move the actuator with hydraulic pressure while monitoring the position. While the general behavior of each hydraulic actuator is similar, the different electronic

interfaces and sensors require us to develop a new test console from custom electronic components, which can often take up to an entire year to test. With National Instruments LabVIEW Real-Time and PXI, we can efficiently develop new test consoles within weeks as opposed to months.

Real-Time Performance

Each actuator is controlled with hydraulic pressure ranging from 3,000 to 5,000 PSI,

while we use a linear variable differential transformer (LVDT) to detect the position of the actuator. A real-time control loop deterministically reads in the secondary values from the LVDT and then uses software to demodulate the signal to determine the position output. We can adjust any error in the position by sending an analog output to a servo amplifier, which pressurizes cylinders with an electro-hydraulic servo valve (EHSV). This entire control loop runs on a headless real-time PXI system with an analog input module reading the secondary values of the LVDT and an analog output module driving the servo amplifiers.

The real-time PXI system is coupled with a Windows-based PXI system that performs some additional data logging and generates signals for the sensors and servo valves. For instance, we use an analog output module to generate the signal necessary for the LVDT sensors, while another module tells the EHSV

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driver where the hydraulic actuator should displace the unit with either a positive or negative degree of pressure.

Reusable Test Console Platform

Using LabVIEW, we can redefine the operation of the two PXI systems to test unique hydraulic actuators. Instead of a 4-wire LVDT sensor, our hydraulic actuator may include a 5-wire LVDT sensor. To accommodate this change, we only need to change the LabVIEW application and then download it to the real-time PXI system. If we must monitor additional signals, we can add more DAQ hardware components

without modifying the software as we upgrade hydraulic actuators. With the reusable console architecture, we can adjust to new hydraulic actuators by simply adding

hardware components or changing the code.

With a new platform based on LabVIEW Real-Time and PXI, we now have a core framework to quickly and easily build new test consoles that we can use on all new applications. This framework eliminates the design cycle for a new application through LabVIEW software and DAQ hardware. It previously cost us as much as \$1.5 million (U.S. dollars) to build a console, but with the LabVIEW Real-Time and PXI framework, the most complex console now costs us only \$250,000 (U.S. dollars) to build. In addition, our application development time dropped from two years to less than eight months.■

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