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Using National Instruments CompactRIO for Load Actuators in Structural Testing

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Industry:

Industrial Controls/ Devices/ Systems, Aerospace/Avionics

Products:

Real-Time Module, LabVIEW, FPGA Module, CompactRIO

The Challenge:

Delivering a user-friendly and reliable system for simultaneous real-time control of multiple test bench load actuators.

The Solution:

Using NI commercial-off-the-shelf CompactRIO hardware we were able to implement all the custom control requirements.



[Gallery](#)

The load control system in industrial 19" 3U rack.

"Although this system has been developed to meet specific demands from S.A.B.C.A., the variety of National Instruments modules and the flexibility of LabVIEW, combined with the strength of our software and electronic departments, make this equipment customizable for a wide range of demanding control applications. "

S.A.B.C.A., a Belgian company active in the aeronautic market, is performing tests on structural elements for different aeronautic and aerospace programs. Their structural test laboratory needed a user-friendly system to ensure a reliable, real-time, closed-loop control of the 8 load actuators of a test bench. WOW Company is a specialist in test & measurement, automation and robotics, was requested to develop such a control system.

The system must also include the signal conditioning for the strain gauges. Measured strain is used as process values for the control system and should follow a load set point profile according to predefined tests. The new equipment must fit in a 19", 3U industrial rack and has to be integrated into an existing industrial cabinet. The real-time, closed-loop control of the actuators is performed by the FPGA backplane (cRIO-9102 module) at a rate of 10 kHz. Using LabVIEW Real-Time and LabVIEW FPGA, we implemented the discrete PID closed-loop in almost no time.

The strain gauges conditioning is achieved by using the NI-9237 module. The system also allows the input of an already conditioned signal from the S.A.B.C.A. acquisition system through a ± 10 VDC NI-9215 module. The generation of the ± 15 mA current to pilot the actuator servo valves could not be achieved directly with National Instruments products, but our electronic department was able to design a small electronic board that transforms the voltage output of the cRIO NI-9263 module into the desired servo valve current.

Set Point generator

The load set point generation is performed by the real-time PowerPC Controller (cRIO-9012) at a rate of 500 Hz. Structural tests are achieved in two different manners:

- Generation of load steps: Each step has a configurable duration and each actuator can have a specified load.
- Generation of load cycles: Each cycle is an arbitrary waveform that can be created in the operator interface software. The number of cycles and cycle duration are configurable.

To avoid unnecessary load constraint on the tested element, smooth load transitions are

computed and controlled by the cRIO-9012

User-Friendly Operator Panel

For test definition and monitoring, user-friendly operator interface software is running on a laptop computer. Communication between the operator interface software and the PowerPC controller software is done through a TCP/IP client-server command exchange protocol. For safety purposes, the cRIO-9012 automatically generates a test stop command when communication with laptop software is lost.

A Customizable Solution

Although this system has been developed to meet specific demands from S.A.B.C.A., the variety of National Instruments modules and the flexibility of LabVIEW, combined with the strength of our software and electronic departments, make this equipment customizable for a wide range of demanding control applications. Adding more channels, modifying the control loop algorithm, using other sensors is possible with minimum development costs.

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