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University Outfits Wind Tunnel with LXI Data-Acquisition System

The wind tunnel is an essential facility for a university aerospace department. Although much work can now be done in a computational fluid dynamics (CFD) simulation environment, prototypes must ultimately be tested in a wind tunnel to validate the computational models and ensure that production aircraft based on the prototypes can safely take to the skies.

With a wind tunnel, researchers can subject physical prototypes of various aircraft types to controlled airflow, allowing them to acquire data on parameters such as lift and drag. They can also analyze the performance of components ranging from engine intakes to wings, studying factors such as pressure distribution and flow separation to maximize efficiency. They can also perform boundary-layer and aeroelasticity studies as well as flight load tests to determine how airflow affects the prototype under the test's structural dynamics—and vice versa. All these efforts in the wind-tunnel environment affect how an aircraft will perform in the real world, and they also generate feedback to improve CFD models to enable more accurate simulations for future projects.

Education and Training

Of course, education and training are key considerations for any facility in a university environment, and a wind tunnel is no exception. A wind tunnel can provide students with hands-on experience, enabling them to conduct experiments and study real-world effects. They can also learn about sensors and data-acquisition systems and how to write test programs and analyze test data.

In pursuit of all these goals, the aerospace engineering department of a university in Western Europe is building a new wind-tunnel facility, and the department has chosen AMETEK Programmable Power's VTI Instruments brand to provide the instruments required for its data-acquisition system to measure strain, temperature, and vibration.

Choosing Data-Acquisition Solutions

The department chose products from VTI Instruments for several reasons. The company offered LXI-based solutions that were easy to start with and have a proven record of high accuracy and reliability over a broad installed base. Support for the IEEE 1588 Precision Time Protocol (PTP) standard enables all instruments to synchronize automatically, a function the department finds extremely useful. In addition, the VTI Instruments solution is easily scalable and cost-effective. Finally, the VTI Instruments solution is flexible concerning the software environment, whereas competitive systems emphasize proprietary software approaches. While VTI Instruments offers its EXLab turnkey software for data-acquisition applications, it is optional. VTI Instruments systems are easily programmable with any open-source language— the approach the department favored.

Strain and Temperature Measurements

The university also chose VTI Instruments products for strain and temperature measurements, including the EX1403A precision bridge and strain-gauge instrument, which features 16 channels of strain or voltage measurement capability with independent 24-bit ADCs per channel. It offers extensive software-selectable filtering and independent signal-conditioning paths. The instrument is particularly applicable to wind-tunnel flight load tests.

The university chose the EX1401 16-channel isolated thermocouple and voltage measurement instrument for temperature measurements, which delivers an accuracy of ±0.20°C, 1,000-V channel-channel isolation, built-in self-test capabilities, and independent 24-bit ADCs per channel. It can acquire data at 20 kS/s/channel to support high-speed transient-temperature applications. The EX1401 offers fully integrated signal conditioning, including independent thermocouple cold junction compensation (CJC) implemented per channel.

The university also needed to measure vibration using integrated electronics piezoelectric (IEPE) accelerometers. It chose the EMX-4350 smart PXIe 625-kS/s 4-channel digitizers to acquire the accelerometer data. The digitizers fit into a CMX09A nine-slot PXIe chassis along with the EMX2500 embedded LXI/PXIe slot 0 controller, which provides Gigabit Ethernet and LXI connectivity and adds IEEE 1588 functionality.

Other products chosen include the EX1200-3608 signal generator, which offers eight independent DAC channels, each consisting of a 16-bit DAC combined with a low-pass filter and an output amplifier. The DAC modules provide an arbitrary waveform generation (AWG) mode along with static output operation. Each channel is true-differential and has sense lines that compensate for voltage drops over the lead wire's length. An EX1202 LXI two-slot half-rack switching and data-acquisition mainframe accommodates the EX1200-3608, and an EX1200-7500 handles digital I/O.

Beyond Aerodynamics

The aerospace department's experience with VTI Instruments' data-acquisition solutions in its wind tunnel project demonstrates the flexibility and scalability offered by products from AMETEK Programmable Power and its VTI Instruments brand. The products are accurate, reliable, and easy to use, and they support industry standards such as LXI and IEEE 1588. As for software, VTI Instruments anticipates that the university community often prefers open-source programming environments and never locks you into a proprietary solution that requires regular, costly upgrades. However, VTI Instruments does offer turnkey software for those who do not want to write source code. For maximum flexibility, VTI Instruments provides drivers of all major computing environments, including Linux, Windows, and LabVIEW, and it even offers instruments that support the Representational State Transfer (REST) programming style; these instruments can be controlled through any browser, with no need for a driver at all.

VTI Instruments' capabilities extend beyond aerospace engineering to embrace any discipline that requires acquiring and analyzing vast amounts of data—be it pressure, humidity, temperature, strain, vibration, or some other parameter.

In addition, AMETEK Programmable Power offers programmable DC power supplies, AC sources, and electronic loads that are often system components from which data is being acquired. Whatever your academic discipline, from environmental engineering to materials science, AMETEK Programmable Power and its representatives are ready to work with you to meet your immediate data-acquisition and programmable power needs while retaining the scalability and flexibility to adapt to changing requirements.