Examining the 10 Most Common PXI Test, Measurement, and Control Applications

Overview

Expanding requirements and unprecedented business constraints present serious challenges for today's test engineers. As devices become more complex, engineers must find ways to increase throughput and explore lower cost solutions. National Instruments has helped companies across industries build more effective automated test and measurement systems. With the NI software-defined approach, thousands of companies are building test systems based on flexible hardware platforms and scalable software. NI's approach consists of three main parts:

1. NI LabVIEW—The leading system design software for automated test that helps you develop powerful test software quickly
2. NI PXI—The leading modular instrumentation platform used to build compact, high-performance automated test systems
3. NI TestStand—A powerful, ready-to-run test management environment that helps you develop automated test and validation systems faster

These key features make the NI automated test platform attractive for a variety of test, measurement, and control applications. Here are the 10 most common application areas to help you better understand how PXI can meet your current and future needs.

Manufacturing Test

Increase throughput and scalability while reducing costs with PXI manufacturing test systems.

As a leader in functional test hardware and software, NI has been at the forefront of the evolution of electronics manufacturing and test. Based on many years of working with electronics manufacturers, NI has built a complete modular hardware and software platform for functional test. This platform offers high test throughput, increased productivity, and a lower cost of ownership than traditional disjoint systems or turnkey solutions based on proprietary architectures.

Bloomy Controls, Inc. had to replace an outdated functional test system used to test printed circuit boards (PCBs) for telephones and communicators. Their solution consisted of implementing a functional test system based on LabVIEW and NI TestStand to increase test accuracy and throughput. The new test systems also have improved Lifeline's test throughput. Testing time for the telephone PCBs decreased from four minutes to two minutes 37 seconds per board, a 35 percent throughput increase. Communicator PCB testing time decreased from three minutes to two minutes 12 seconds per board, a 27 percent throughput increase.

"The NI devices and Bloomy Controls test architecture and user interface have made the difference in accuracy and ease of controlling the test systems," said Elaine Fasoli Bailey, Lifeline manager of quality assurance and process control. "This has resulted in consistency between tests at Lifeline and its contract manufacturer and great yields at AQL. This has also resulted in less rework for Lifeline Production, ease in updating the system with new tests at Lifeline, and remote updates at the contract manufacturer for engineering."

Electronics Validation and Characterization

Use PXI to automate commonly repeated measurements in your validation labs to compare device functionality, including parametric values and electrical characteristics, with design specifications.

The LabVIEW and PXI test and measurement platform delivers industry-leading measurement flexibility and easy test repeatability required in electronics validation and characterization systems across military and aerospace, telecom, automotive, semiconductor, and consumer electronics applications. Using PXI combined with LabVIEW graphical programming software and NI TestStand test management software, you can automate your entire characterization process through development, sequencing, and looping of measurements for complete component or device characterization.

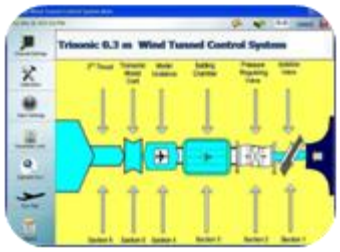
Texas Instruments has been producing a significant portion of the world's semiconductor chips for more than 45 years. With close to $4 billion in revenue, TI is one of the leading wireless IC providers. However, as design growth increases linearly with new product introductions, characterization of dozens of tests has increased exponentially, creating a design bottleneck.

By using commercial off-the-shelf software technologies such as NI TestStand and LabVIEW, they achieved the level of commonality, maintainability, and reuse with their characterization platform to keep up with the design of new components. Using virtual instrumentation has helped them expand their $4 billion wireless and RF business without sacrificing quality and doubling the number of test engineers.

Data Logging

Perform common data-logging measurements, including temperature, pressure, current, velocity, strain, displacement, and other physical phenomena, with PXI.

Whether you need a simple data-logging solution or you wish to create a custom solution with 2,000 or more channels, PXI provides the hardware scalability you need. Use the interactive DAQ Assistant in LabVIEW or the online NI Measurement Hardware Advisor to determine the best hardware for your application based on channel count, sensor type, acquisition speed, and measurement accuracy. Increasing the number of channels in your data-logging application using LabVIEW helps you avoid the cost of purchasing additional stand-alone data loggers. You also can quickly add nontraditional measurements including digital I/O, video, and CAN bus communications.



Wind tunnels are an important testing tool for ground-based aerodynamics studies for aircraft and other moving objects. A large wind tunnel facility required a solution for automated control of the various operations of one of its wind tunnels. This tunnel was a trisonic 0.3 m wind tunnel for testing in subsonic, transonic, and supersonic modes. The data acquisition system recorded important data through sensors mounted on the model.

With reliable NI hardware and LabVIEW software for test and measurement, they are developing and deploying a rugged and highly precise data acquisition and control system. The system is user friendly for beginners and provides low-level control over the tunnel for veterans. The high data-acquisition speed and processing capabilities of NI hardware made it possible to have multiple simultaneously executing proportional integral derivative (PID) control loops.

Structural/Mechanical Test

The PXI and LabVIEW graphical development platform is ideal for designing structural and mechanical test systems, including noise, vibration, and harshness (NVH) test; structural vibration monitoring; and noise mapping.

Mechanical analyses, such as modal analysis and operational deflection shapes (ODS), for physical structures, such as bridges, oil drilling platforms, car chassis, air frames, and seismic studies, require high channel counts and complex computation and visualization to understand the behavior of vibrating structures. LabVIEW can manage the high data throughput from PXI, advanced modeling, deterministic performance, and computationally intensive display required for structural analysis.

PXI and LabVIEW are commonly used for many types of structural analysis, including static, fatigue, dynamic, or shock tests. Many of these tests combine measurements of strain, vibration, pressure, and force into a single mechanical analysis. PXI dynamic signal acquisition and SCXI modules offer cost-effective mixed-signal data acquisition (accelerometers, strain gages, pressure transducers) for both small- and full-scale structures. Deploy PXI test systems for wind tunnels, shaker tables, hammer/impact tests, pass-by noise, acoustic holography, sonic/high-intensity noise tests, and frame responses.

Noise mapping and monitoring is another key mechanical test analysis available with PXI and LabVIEW. With noise-mapping systems, automotive manufacturers, for example, are increasingly able to detect the

point source of excess noise and correct the causes. Using LabVIEW, you can conduct acoustic holography by creating 3D holograms from “photographs of sound” taken with an array of microphones connected to PXI dynamic signal analysis hardware. Through the phase relationship between the microphones in the array, you can localize the source of louder noises.

As part of the Quiet Technology Demonstrator 2 (QTD2) project, Boeing flight tested new technologies intended to reduce noise generated by its aircraft. Measuring the improvement these technologies provide required a flexible, accurate, and scalable test system to perform phased array acoustic imaging during the tests. They needed a distributed system architecture with the ability to expand to up to 1,000 channels or more while still maintaining tight timing and synchronization between channels.

Using NI software and hardware, they created a high-end, low-cost system that could distribute the acquisition system across multiple chassis, tightly synchronize all channels, provide high channel count with full bandwidth on all channels simultaneously, and allow virtually unlimited channel count expansion. With this new system, not only were they able to improve capabilities of the individual acquisition channels, but they also achieved a 5:1 reduction in the amount of cable required and cut the cost of microphone systems by 30:1 for flyover test applications.

Hardware-in-the-Loop (HIL) Test

Achieve highly realistic simulation of your plant models using PXI and LabVIEW to perform control and analysis.

The NI HIL test platform uses open hardware and software technologies to reduce the time, cost, and risk associated with control system development. These solutions scale from low-cost PC-based testers to high-performance multicontrollers and can improve system integration of test applications as well as provide test solutions from requirements definition to manufacturing test.

Lear Corporation’s Electronics division designs and manufactures embedded control electronics for automotive applications including interior and exterior lighting control, power management systems, locking control, and tire pressure monitoring systems. Embedded software is a major component of these products and the content and complexity of this software is growing exponentially. They use HIL testing extensively because it gives them the ability to efficiently scale testing capacity and increase test coverage to address these growing complexities. However, their previous HIL test platform did not provide the stability, intuitiveness, or flexibility necessary to achieve their desired quality standards.

Using NI VeriStand and PXI-based HIL systems, Lear was able to continually run their system for more than one year without experiencing a tester failure. This stability combined with the efficiency gains achieved with NI VeriStand and the NI hardware

products has given their team the ability to identify more issues during the early stages of development and resolve them faster, which has decreased our warranty issues and returns.

RF and Communications Test

Use PXI to tackle the ever-changing requirements imposed by the proliferation of wireless capabilities into nontraditional markets.

Engineers involved in wireless design and test are facing the increase of wireless subsystem integration into larger designs. NI provides modular test solutions for cellular (2G, 3G, and 4G), wireless connectivity (WiFi, Bluetooth, and NFC), and navigation (GNSS) standards. These test systems provide up to 5X the speed of traditional wireless test sets and feature the upgradability to generate or analyze the latest wireless standards. They also offer the performance you need for design or validation environments and the speed you need for high throughput manufacturing environments.

TriQuint is a leader in high-performance RF solutions for sophisticated mobile devices, defense and aerospace applications, and network infrastructure. At TriQuint Semiconductor, they needed to test these increasingly complex parts across a wide range of frequencies, voltage supply levels, temperatures, and power ranges. The complete characterization process for a typical part requires 30,000–40,000 lines of data to completely test the design.

With traditional rack-and-stack RF test equipment, it took roughly 10 seconds to collect each line of data, which required more than 110 hours of testing for each individual part. Using PXI to perform the bulk of the measurements on their PA test bench, they shortened the characterization time of their PAs from two weeks to about 24 hours. Also, they observed significant improvements in measurement time for each of GSM, EDGE, and WCDMA measurement test.

Machine Automation

Solve complex machine automation application challenges with the flexibility of PXI, including sound and vibration monitoring.

The LabVIEW industrial control platform has the flexibility and features to solve complex machine automation applications with requirements such as closed-loop discrete control, custom multiaxis motion control, custom programmable logic, integrated machine vision, interactive human machine interface (HMI), data logging, web connectivity, and real-time signal processing. LabVIEW and PXI also help you create machine automation solutions reliable enough to perform time-critical operations and rugged enough to withstand environmental conditions.

Because LabVIEW provides a full-featured graphical programming language, you benefit from both rapid development and the ability to program low-level functions. This sets LabVIEW apart from traditional programmable logic languages that lack flexibility and cannot adequately meet complex machine automation requirements. Machine automation system designers can choose from an extensive portfolio of built-in analysis routines, including those for common control algorithms such as PID and frequency analysis, and they can program advanced control and connectivity through networking functions.

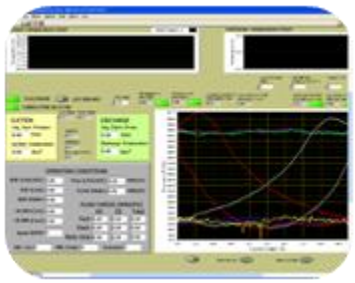
The University of Colorado at Boulder had a previous centrifuge control system that was based on proprietary hardware and software. It was extremely complicated with more than 300 discrete digital I/O lines, most of which were dedicated to operating a hard-wired control panel. The fixed control panel layout and the 2,000+ lines of vintage programmable logic controller (PLC) code made it impossible to add functionality to the system. As the system aged, pieces of it began to fail. Repairs required time-consuming troubleshooting, and downtime was excessive. They decided that they needed a new modern control system based on PC technology. They also needed a system that they could maintain and easily update.

Using PXI and LabVIEW paired with a wide range of NI programmable automation controller (PAC) products they replaced the existing PLC control system with a modern control system, and built a flexible data acquisition system based on NI hardware and software in less than four months. The high level of integration and modularity provided by the PXI platform increased the reliability and productivity of the centrifuge lab dramatically and resulted in much simpler and more powerful systems.

Machine Condition Monitoring

Take advantage of the fully integrated test and analysis capabilities of LabVIEW and PXI for machinery condition monitoring and machine test for in-plant or factory-test use.

NI is empowering engineers to develop industrial embedded systems for monitoring and control. You can use NI tools to create machine condition monitoring systems. Condition-based maintenance systems help decrease unscheduled outages and optimize machine performance while reducing maintenance and repair costs. NI hardware and software are used in condition monitoring systems deployed on a variety of turbines, compressors, generators, and other industrial machines.



Quantum Controls, Inc. had the challenge of designing a gas compressor data acquisition system capable of synchronizing samples from multiple sensors to the rotational position of the pistons' crankshaft and performing measurements from field mounted meters and thermocouples.

Their solution required acquisition of a variety of signal types across a broad range of acquisition speeds. The use of high-speed data acquisition and flexible field sensor monitoring was made easier by using multiple NI data acquisition platforms. They can now monitor data precisely acquired with respect to the system's operations. In addition, they can automate and present calculations and report generation in an easy-to-use and clear format.

Power Monitoring

Perform power metering and power quality measurements with the test and analysis capabilities of LabVIEW and PXI.

In each step of a power chain, you need to measure and control the quality and amount of power. NI provides tools to perform power quality monitoring, power metering, and distribution monitoring. Whether you are in-plant or factory-test focused, you can find the test and analysis you need from the LabVIEW and PXI all-in-one platform, including:

- Online and offline analysis capabilities
- High-speed time waveform logging
- Ethernet connectivity with client/server architectures
- Synchronized measurements for electrical power voltages, currents, and digital switchgear
- Power quality measurements, including power factor, power metering, harmonic distortion, and transient events
- Extensive graphical plotting capabilities, including polar plots, time waveform plots, and statistics
- Alarming, reports, and data management
- Sequence of events recorder
- An extensive math analysis toolkit for advanced analysis

The UPS industry is dramatically changing. Power providers and users concerned about reliability are increasingly focused on power quality, power protection, and power station health. One way to ensure reliability is to remotely monitor UPS power system performance. Some systems and applications are restricted by a centralized control format. These systems cannot monitor and control a UPS power station, as there is insufficient data for analyzing power station parameters, security, and environment health monitoring.

The UPS power station monitoring system that Captronic Systems developed using NI hardware and software is a reliable, consistent solution for the UPS power industry. The system provides an integrated solution for monitoring UPS power station devices and sensors. They can perform data acquisition, report generation, real-time data monitoring, and control using a single platform. Using this system, they avoid integration issues and greatly reduce development time. This UPS power station monitoring and security system helps the UPS power industry improve electrical network conditions and meet future challenges.

Integrated Test and Control

LabVIEW and PXI are ideal for developing applications that integrate test and control such as electromechanical test, environmental test, and fatigue test.

LabVIEW software flexibility combined with powerful, rugged NI real-time PXI hardware and an extensive array of I/O helps you create applications that feature the high-accuracy measurements of advanced instrumentation with precise, deterministic control. By performing the test and control portions of an application with the same hardware and software, you can significantly reduce development time and cost.

The LabVIEW parallel dataflow programming model is optimized for programming control applications. Using LabVIEW add-ons such as the LabVIEW Real-Time and LabVIEW FPGA modules, you can ensure reliable, deterministic execution of your applications for precise control of mechanical structures, environmental chambers, motion control, and emergency shutdown procedures. By using real-time OSs and rugged PXI hardware, you also gain the reliability you need for long, extended-duration test runs.

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) and Control Systems Division-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 hydromechanical, fly-by-wire, power-by-wire, electromechanical, and electrohydrostatic actuation with a variety of hydromechanical products that require testing.

With a new platform based on LabVIEW Real-Time and PXI, they now have a core framework to quickly and easily build new test consoles that they 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 them as much as $1.5 million USD to build a console, but with the LabVIEW Real-Time and PXI framework, the most complex console now costs them only $250,000 USD to build. In addition, their application development time dropped from two years to less than eight months.