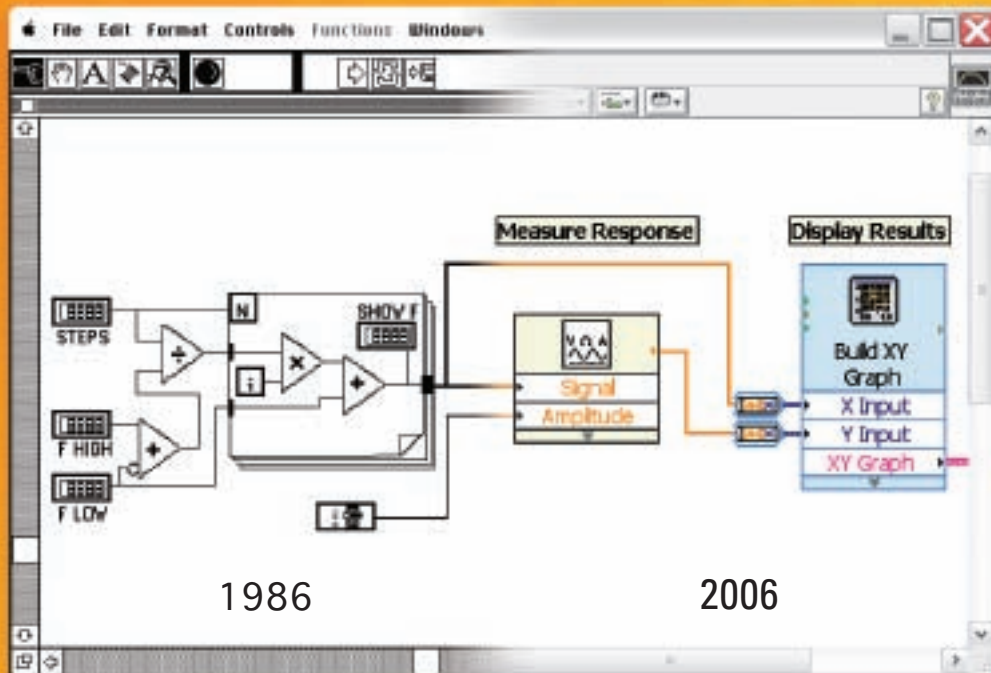


Instrumentation Newsletter

The Worldwide Publication for Measurement and Automation | **Third Quarter 2006**

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Customized Information through RSS

We know most of you read *Instrumentation Newsletter* as a way to stay abreast of new technologies, new products, and application stories.

With every issue, we do our best to provide technical content to meet the needs of the very large and diverse readership we have, but like all print publications, there are limitations in terms of how much information we can feature in one issue.

On the other hand, the Internet includes an over-abundance of information. The emergence of Google, Yahoo, and other search technologies has been somewhat of a “killer app” to help sort through the massive amounts of information online.

Instead of skimming through search results, what if you could receive regular updates when new information is available that is of interest to you? Thanks to a new technology known as Really Simple Syndication (RSS), it is becoming possible for you to subscribe to a news or content feed for the information you want. Initially, most RSS feeds are set up for specific information, such as an RSS feed for headlines from CNN.com. Today, a simple software application known as a news reader checks for any new information from your subscribed feeds and displays it when you want it. Microsoft, Google, and others are working on ways to embed news readers within common applications or Web sites we already use.

National Instruments has remained at the forefront of RSS technology, and now on

ni.com, we have combined RSS and search technology to let you create a truly customized news feed. For example, if you want to receive updates any time NI releases new information on ni.com related to LabVIEW and RFID, you could, of course, search for “LabVIEW” and “RFID” on the NI Web site for links to all the relevant information, but you would have to check back regularly for new posts.

Now, you can go to ni.com/rss and set up a customized RSS feed on any search terms you desire. Using the example above, when NI publishes new content related to LabVIEW and RFID on ni.com, you receive the information in your news reader. This information includes not only product and technical information posted by NI, but also customer stories or forum postings from users related to LabVIEW and RFID. In other words, you have created your own custom LabVIEW RFID newsletter!

There is no limit to how detailed or how broad you make your search criteria when setting up your customized NI news feed. This is just another example of how we are helping you stay abreast of the technology and application information you want. ■

John Graff
 Vice President of Marketing



Retinal Disease Treatment with Intelligent DAQ

Traditional methods of pan-retinal laser photocoagulation to treat retinal diseases caused by diabetes have changed little in the past 35 years.

Laser photocoagulation involves the controlled destruction of the peripheral retina using targeted laser pulses. While this type of treatment has proven effective at reducing the chances of vision loss by as much as 50 percent, it can be very tedious to both patients and doctors. Ophthalmologists can deliver only one burn at a time, and treatment may require as many as 2,000 burns. A full course of treatment typically requires two to four sessions, each lasting 12 to 15 minutes.

OptiMedica specializes in designing medical devices that help ophthalmologists improve the way they treat retinal disease. The company designed the PASCAL photocoagulator to be a fully integrated pattern scanning laser system that provides significantly improved performance for the doctor administering the treatment, as well as an enhanced therapeutic experience for the patient.

Engineers at OptiMedica are experienced National Instruments LabVIEW users, so they chose the NI LabVIEW FPGA Module and an R Series intelligent data acquisition (DAQ) board instead of a custom hardware solution for the PASCAL photocoagulator. A single National Instruments PCI-7833R intelligent DAQ board controls the entire system; its hardware determinism offers faster retinal scanning, significantly reducing the number of patient office visits. With the LabVIEW graphical development platform, OptiMedica engineers quickly and efficiently designed and prototyped their machine using customizable off-the-shelf PXI hardware and successfully demonstrated the system to potential investors. Given how well the prototype met their requirements, they

knew that LabVIEW would give them a smooth migration path to deploy the final system on PCI intelligent DAQ hardware.

The PASCAL photocoagulator takes advantage of the precise timing and triggering achievable with R Series intelligent DAQ hardware. With conventional methods of retinal laser photocoagulation, the doctor uses a mechanical joystick and foot pedal to deliver a single 100 ms laser pulse to abnormal blood vessels of the peripheral retina. OptiMedica discovered that automatically delivering multiple, shorter pulses rather than a series of manually placed lesions offers greater precision and safety. Further, the PASCAL system greatly reduces the risk of inadvertent treatment



The PASCAL system from OptiMedica uses NI LabVIEW FPGA and the NI PCI-7833R intelligent DAQ device to improve pan-retinal laser photocoagulation treatment of diabetes-related retinal diseases.

With the LabVIEW platform, OptiMedica engineers quickly and efficiently designed and prototyped their machine using customizable off-the-shelf PXI hardware.

application to the center of the fovea, which can result in localized vision loss; doctors using conventional photocoagulation methods must manually attempt to avoid this critical central vision region.

Using LabVIEW FPGA technology, engineers at OptiMedica were able to automate this proven procedure with speed and reliability. The PASCAL photocoagulator successfully reduces treatment duration and patient discomfort. It also potentially

reduces the number of treatment sessions, thereby reducing costs to both doctors and patients and making it very popular among lead users. ■

To read the “R Series Intelligent DAQ with Onboard Processing” data sheet, visit ni.com/info and enter **nsi6301**.

NI LabVIEW 8.20 Marks 20 Years of Innovation

In this article, Jeff Kodosky, the father of LabVIEW, celebrates 20 years of innovation with a letter to LabVIEW developers.

Dear LabVIEW Developers,

It was a little more than 20 years ago when we first formed ideas of what is now known as LabVIEW. We had a vision to create something that would do for engineers and scientists what the spreadsheet did for financial analysts. What started as an idea in 1984 turned into the first LabVIEW release – LabVIEW 1.0 on the Apple Macintosh Plus in 1986. While a lot about LabVIEW has changed since 1986, its purpose and core concepts remain the same.

Today, the 20th anniversary edition of LabVIEW, LabVIEW 8.20, adds the ability to combine textual math with graphical programming, features object-oriented programming, and offers improvements for designing and targeting embedded devices. LabVIEW 8.20 does this by building on the principles that led to the first version in 1986 and to the success of LabVIEW over its 20-year history.

I attribute much of the LabVIEW development ease of use to two fundamental concepts – the front panel and block diagram, both present since LabVIEW 1.0. Creating a UI by dragging and dropping controls and indicators and writing the code by wiring icons together are key elements of LabVIEW. The original LabVIEW block diagram has improved by including additional models of programming. We now have an event structure as well as custom timing structures, such as the timed loop and new diagram types, which include the simulation diagram. When we

created LabVIEW 1.0, it was possible to control instruments over GPIB. With LabVIEW today, we have the power to run real-time applications, develop custom hardware using FPGAs, create communications and RF test systems, and design systems with embedded 32-bit processors.

Throughout the development of LabVIEW, we have been committed to creating an open environment that provides connectivity to NI and third-party hardware and includes tools to reuse external software with LabVIEW.

As we have released new versions of LabVIEW, I am constantly amazed at how you have used the software to meet your application needs. One such application is from Christopher Atwood of Tristan Technologies, Inc. (see Figure 1). This application uses LabVIEW to monitor and diagnose brain activity in infants at severe risk of developing cerebral palsy and epilepsy, so medical doctors can intervene at an early stage. Without formal software development



Figure 2. Powered by LabVIEW, LEGO MINDSTORMS NXT software puts graphical programming in the hands of children building next-generation robotics.

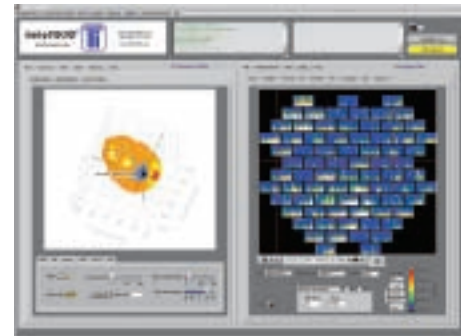


Figure 1. Using LabVIEW, Tristan Technologies, Inc., developed an application that monitored infant brain activity in less than one year.

training, a single engineer and domain expert developed this advanced application in less than one year using NI PXI hardware and LabVIEW software.

It also has been exciting for me to see how LabVIEW itself is increasingly developed in LabVIEW, sometimes referred to as “eating your own dog food.” Many of the features you see today in LabVIEW, including the application builder, are developed in LabVIEW. Its ease of use as well as our ability to develop within the software have been key to our collaboration with LEGO®, which led to the creation of LEGO MINDSTORMS® NXT, the next-generation robotics platform from LEGO. Based on LabVIEW, MINDSTORMS

NXT uses intuitive icon-based programming and provides easy-to-use development for younger users and the extensibility to create sophisticated robotics programs (see Figure 2). I am excited to see what the future brings with this new crop of graphical programmers.

As both customers and LabVIEW enthusiasts, you not only have delivered applications with LabVIEW, you also have helped shape the features and direction of LabVIEW.

LabVIEW 8.20 is no exception.

As your applications have grown in complexity and the number of

developers working on projects has increased, you have asked for better tools to manage your applications and development. LabVIEW 8.20 adds object-oriented programming so you can extend modular code development beyond subVIs and project libraries. Your need to develop textual math algorithms with LabVIEW has led to MathScript, an interactive textual math editor in LabVIEW,

and the ability to embed your scripts into the block diagram of your VIs.

As we release each version of LabVIEW, we look at the future to see how LabVIEW can meet your evolving needs. The last 20 years have been an exciting time for all of us. We are just getting started with the next 20 years, and I look forward to

continuing to work with you, the LabVIEW community, to build this future together. ■

Sincerely,

Jeff Kodosky

Explore NI LabVIEW 8.20, the 20th Anniversary Edition

- **MathScript textual math** – Reuse your m-file scripts created with The MathWorks, Inc. MATLAB® software in LabVIEW to instrument your algorithms.
- **Object-oriented programming** – Apply object-oriented design for modular and extensible LabVIEW development. See page 16 for details.
- **3D picture control** – Create advanced user interfaces with OpenGL-based 3D visualization and take advantage of hardware acceleration.
- **.NET Web services** – Integrate .NET Web services with automatic generation of VI interfaces.
- **Simplified method to call DLLs** – Automatically generate VI interfaces for calling DLLs.
- **Dynamic VI and DLL calling** – Easily call VIs and DLLs dynamically through configuration dialogs.
- **High-speed data streaming** – Stream structured binary technical data management (TDM) format data to disk.
- **Distributed intelligence** – Develop human-machine interfaces (HMIs) with the new LabVIEW 8.20 Touch Panel Module for Windows CE devices and share data with handheld devices through shared variable support for PDAs.
- **PC to real-time system conversion** – Use your standard PC as a desktop-based real-time system.
- **Custom data acquisition (DAQ) board creation** – Automatically generate code for FPGA-based devices to create custom I/O hardware and timing diagrams.
- **Embedded devices** – Take your simulations to embedded 32-bit processors and target new processors with the LabVIEW Embedded Development Module.
- **Communications system design** – Create standard and custom modulation and channel models with the LabVIEW Modulation Toolkit.

To learn more about the Tristan Technologies, Inc., infant brain monitoring application; LEGO MINDSTORMS; and new features in LabVIEW 8.20, visit ni.com/info and enter **nsi6302**.



Figure 3. Interactively instrument your algorithms by combining textual math and graphical programming.

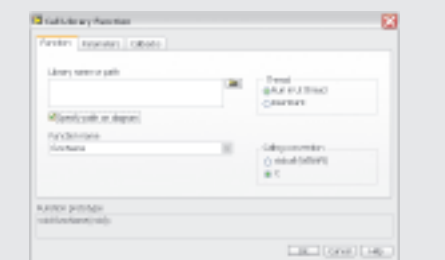


Figure 4. Easily make remote DLL calls.

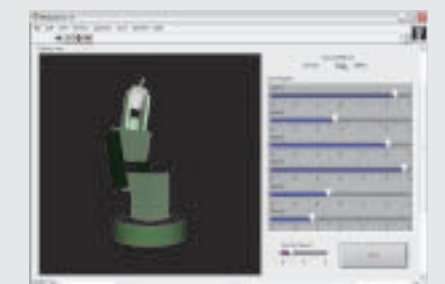


Figure 5. Include 3D models in user interfaces with OpenGL-based tools.

Top Five NI Industrial Releases of the Year

With hundreds of new industrial control products, it is difficult to keep up with all the improvements and capabilities of programmable automation controllers (PACs).

While engineers and scientists often use PACs for basic automation, they are designed to excel when performing difficult applications such as adding high-performance measurements to existing automation systems or performing complex control. Celebrating 20 years of National Instruments LabVIEW innovation with the release of LabVIEW 8.20, it is appropriate to review the top five industrial releases of the past year.

5. Advanced IP for LabVIEW FPGA



Figure 1. NI LabVIEW 8.20 introduces new FPGA IP with functionality for vibration analysis and 64-bit numbers.

By deploying directly to hardware with the LabVIEW FPGA Module, you can build both high-speed and reliable systems. Because most FPGAs lack floating-point processors, algorithm development can be challenging. LabVIEW offers built-in intellectual property (IP) blocks to solve problems in common applications such as PID control, data logging, and vibration analysis. New signal processing algorithms introduced with LabVIEW 8.20 include DC, root-mean-square (rms), analog period measurement, and Butterworth filters. LabVIEW 8.20 also introduces support for 64-bit numbers so you can perform more complex and higher fidelity math operations

in FPGA hardware. For advanced signal processing, you can create your own custom multirate filtering and data reduction IP with the updated LabVIEW Digital Filter Design Toolkit. By taking advantage of these improvements, you can implement even more sophisticated applications in FPGA hardware, such as machine protection in which vibration or electrical power signals are analyzed in real time and the machinery is automatically shut down by the FPGA in the event of a fault.

4. I/O Servers

I/O servers establish a core architecture for open industrial communication from LabVIEW so you can build networked distributed I/O systems that involve hardware from a variety of vendors via standard protocols such as Modbus. Additionally, the I/O server architecture works with OLE for process control (OPC) versions 2.x and 3.0, so every networked



Figure 2. I/O servers provide direct connectivity to third-party hardware and software.

shared variable, NI-DAQmx global task, and FieldPoint I/O item can be automatically shared throughout the network for third-party OPC client interaction with NI software and hardware. For more complex communication tasks, LabVIEW provides the capability to create your own custom I/O server running in the background either periodically or as an event-triggered task. These custom I/O servers can include any LabVIEW VI and can communicate to third-party hardware, automatically log to a database, trigger I/O, or launch other programs.

3. NI CompactDAQ



Figure 3. NI CompactDAQ combines the ease of use of USB with the rugged I/O of NI CompactRIO.

By combining the ease of use of USB, the flexibility of NI-DAQmx driver software, and rugged I/O modules from NI CompactRIO, NI CompactDAQ is designed to meet the needs of non-real-time, PC-based industrial measurement and control. The 8-slot chassis supports up to 256 channels of electrical, physical, and mechanical signals; features hot-swappable and auto-detectable modules; and offers up to 2,300 V_{rms} of isolation. Advanced features, such as four dedicated USB signal streams for synchronous analog and digital I/O, make it ideal for waveform-intensive applications including vibration monitoring and high-speed data logging.

2. The LabVIEW Project

The LabVIEW Project makes it easier to design applications by providing a common view of all system components and by incorporating basic configuration and management tools directly in the

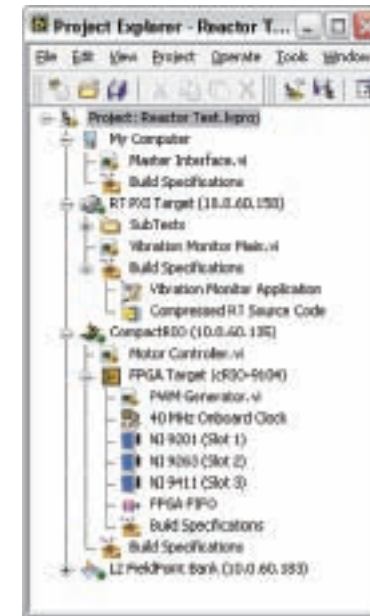


Figure 4. The LabVIEW Project delivers system-level application management across multiple targets.

LabVIEW environment. LabVIEW 8.20 extends this capability to include embedded devices programmed with the LabVIEW Embedded Development Module and human-machine interfaces (HMIs) running Windows CE with the LabVIEW Touch Panel Module. The software also delivers the infrastructure that allows multiple concurrent LabVIEW applications to be targeted to different devices. With these features, you can debug an application running on a real-time PAC while interacting with the system using a deployed Windows-based HMI. Finally, the LabVIEW Project also provides tools for managing and organizing application development and deployment. You can use the LabVIEW Project to group LabVIEW VIs and other files such as design specs or documentation, create build specifications, and deploy or download files to LabVIEW

targets. All the information is stored in a human-readable XML project file (.lvproj) you can track with source code management tools.

1. LabVIEW Shared Variable

The shared variable is a new communications object in LabVIEW that features the ease of use of global variables and built-in networking support. By clicking and dragging shared variables, you can quickly and easily establish communication among multiple real-time controllers, applications, HMIs, and external systems. For real-time performance, you can use real-time FIFOs so control loops perform communication without inducing jitter. To maximize data transfer speeds, the shared variable engine applies user datagram protocol (UDP) for fast multicast data transfer and implements both an error-checking mechanism to ensure data was received and optional data buffering for lossless communication. The shared variable is also the key technology in providing a unified

environment for control, logging, HMI, and external communication. The shared variable unifies experiences with the LabVIEW Datalogging and Supervisory Control and Real-Time modules, provides built-in logging, and simplifies the creation and management of high-channel-count systems. LabVIEW 8.20 introduces new tools for programmatic batch creation of shared variables, so you can create and configure thousands of shared variables; bind them to data acquisition, NI FieldPoint, or OPC tags; and automatically scale, log, and share data across the network. ■

Todd Walter
Industrial Measurement and
Control Group Manager

To learn about five additional industrial releases, including the FPGA Wizard, MathScript, and Gigabit Ethernet, visit ni.com/info and enter **nsi6303**.

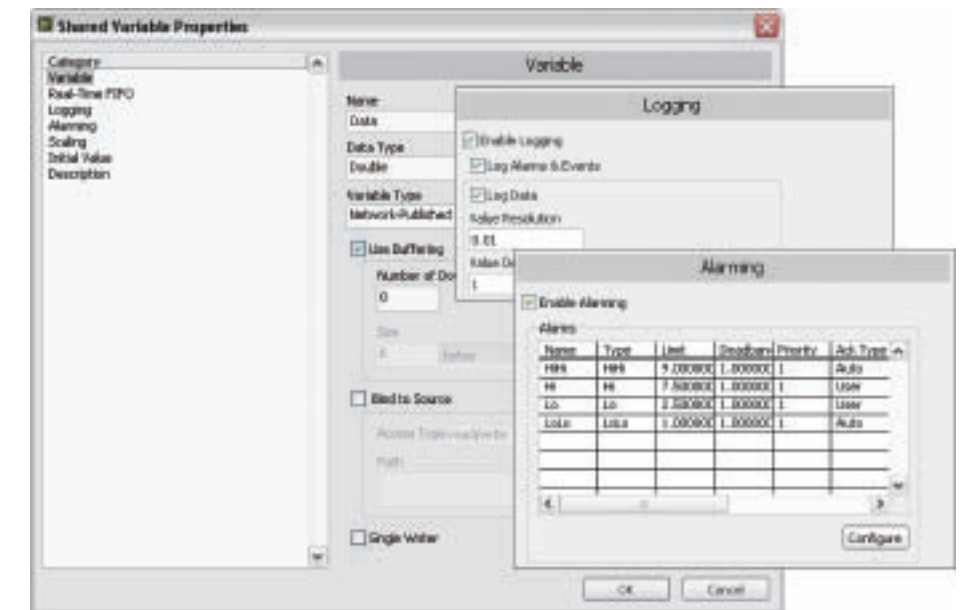


Figure 5. The LabVIEW shared variable unifies communications, logging, and alarming.

Measurement-Ready Options for OEM Designers

OEM engineers have a wide range of development options, from designing at the component level to optimize cost to developing at the subsystem level to dramatically cut development time. Often, making a good decision on these trade-offs is the difference between profit and loss. For lower-volume OEM designs in the hundreds to thousands of units per year, “application-specific” subsystems are often used to prototype, get to market quickly, and test market acceptance before starting a cost-optimized custom design. This OEM subsystem trend has already occurred in many areas. Liquid crystal display (LCD) subsystems are one example – a display subsystem may have connectors, the LCD, a backlight inverter, and special bus interfaces all on a single board ready to connect to other subsystems. This trend applies to measurement and control as well. Table 1 shows some examples of OEM equipment requiring measurement and control capabilities in a subsystem.

Measurement-Ready OEM Subsystems Defined

One example of a measurement-ready OEM subsystem used in production equipment is the National Instruments LabVIEW FPGA and NI CompactRIO platform, which delivers the following features:

- High-level graphical system design software for application development
- Application programming interface (API) for measurement and control
- Off-the-shelf measurement and control I/O modules
- Open architecture for custom I/O module designs
- Easy networking and interfacing to other embedded subsystems
- Advanced signal processing and control features
- Small size that runs on DC voltage
- Low price

Machine/OEM Equipment	NI Customer Solutions	Measurement Capabilities	Control Capabilities	Other I/O
Food packaging/canning machines	✓	Temperature, strain, encoder, current	Motion control, power drive, sorting, dispensing	Ethernet, Fieldbus
Wind turbine monitoring system	✓	Vibration, speed, power	Digital I/O alarm	Wireless
In-vehicle data logger	✓	Temperature, sound, vibration	LIN, CAN	GPS, wireless
Medical laser device for eyesight correction	✓	Image processing, analog voltages	Power source	Ethernet, USB
Biotech microfluidics and liquid-handling machines	✓	Optical power, voltage	Laser control, motion control	Ethernet
Semiconductor metrology or lithography tool	✓	Analog voltages, industrial digital I/O	Motion, power drive	Ethernet
Mass spectrometer analytical instrument	✓	Voltage and current, counter/timer, quadrature	Pulse generation	Serial
Oil field monitoring system	✓	Flow, temperature, pressure	Digital I/O alarm	USB
Precision farm equipment	✓	Analog voltages, industrial digital I/O	Motor control, power drive	CAN

Table 1. National Instruments offers a broad assortment of measurement and control solutions for OEM devices. Visit ni.com and search on keywords from the “Machine/OEM Equipment” column above for more information.

The CompactRIO platform uses a field-programmable gate array (FPGA) as the core processor and a 32-bit processor for signal processing, supervisory control, and networking. With an FPGA, a design engineer can program electrical connections for a specific application without paying tens to hundreds of thousands of dollars to have the application-specific integrated circuit (ASIC) manufactured in mass quantities. Another benefit of the FPGA versus an ASIC or custom circuitry is that an FPGA can be reprogrammed. With NI LabVIEW FPGA, engineers can program the FPGA graphically, greatly simplifying development. The CompactRIO hardware platform provides direct access to the I/O circuitry of each plug-in, hot-swappable I/O module. Each module includes built-in connectivity, signal conditioning, conversion circuitry (analog-to-digital or digital-to-analog), and an optional isolation barrier. Using this low-cost, open architecture, developers can make their own custom modules. Today, National Instruments offers more than 30 I/O modules, including general-purpose I/O, machine monitoring, strain, power drive, and Controller Area



Figure 1. The NI CompactRIO hardware platform is an FPGA-based, reprogrammable measurement-ready OEM subsystem.

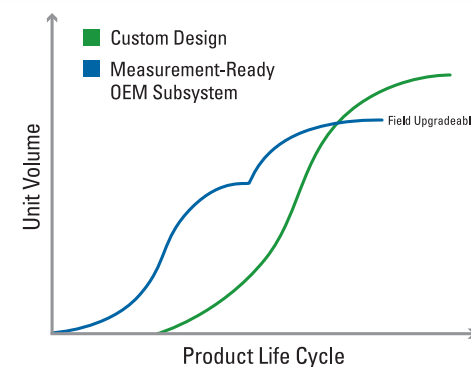


Figure 2. FPGA-based measurement-ready OEM subsystems such as CompactRIO get lower-volume OEM applications to market faster, custom designs take longer but target higher-volume applications.

Network (CAN) modules. Several third-party vendors, including Freescale, offer more than 20 I/O modules for CompactRIO (see page 26).

Jump-Start Embedded Designs

Shorter product life cycles put greater pressure on OEM developers to bring new designs to market faster. Figure 2 illustrates how an FPGA-based measurement-ready OEM subsystem such as CompactRIO gets an application to market faster, while custom designs take longer but may target higher-volume applications. Developers who design at the component level often overlook the benefit of using an easy-to-program subsystem that is field-upgradeable. A reprogrammable FPGA can add new features to an initial design, reach new customers, and extend the product’s time in market.

Design, Prototype, and Deploy

Using measurement-ready subsystem hardware and graphical system design software, OEM developers can design, prototype, and deploy solutions faster than ever. The design process starts with simulating and evaluating design options using LabVIEW for signal processing, control design, state control, and debugging. The next step is to prototype the subsystem with the other embedded subsystems, in which developers validate and perform system tests on the design. Finally, developers deploy the system and perform field testing. All of these

steps can be simplified using LabVIEW FPGA.

Many NI customers, such as General Motors, Boston Engineering, and FEO Medical, report that LabVIEW increases their productivity and helps them design systems in a third of the time of past designs.

Subsystem Service, Support, and Part Management

Other key issues for OEMs are service commitments and part management. Product life cycles for OEM devices can vary from just a few years to a decade, as shown in Figure 3. The subsystem supplier must be able to deliver the service and equivalent functionality needed over the lifetime of the OEM design. Often service, support, and part-management cost considerations are overlooked because hardware prices are easier to calculate.

Finally, building an OEM device using a measurement-ready subsystem offers several inventory and part-management advantages. OEM developers essentially outsource the negotiation and acquisition of long-lead-

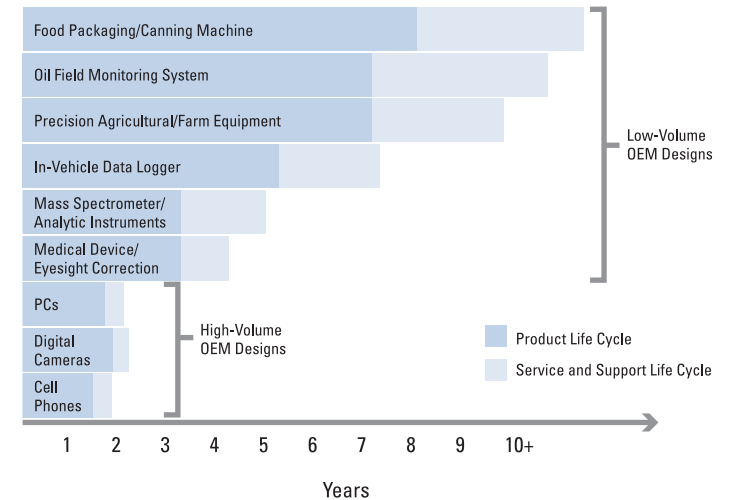


Figure 3. Product and service and support life cycle requirements for OEM designs can vary significantly.

time parts to the subsystem supplier, who assumes responsibility for the scheduling and component availability risks associated with the subsystem. It is also simpler and more cost effective for the equipment maker’s manufacturing group to manage parts. There is only one subsystem part rather than hundreds of components on the bill of material.

System Engineering versus Custom Design

Taking advantage of measurement-ready subsystems can save time to market and lower part-maintenance issues without sacrificing performance. New measurement-ready subsystems such as CompactRIO that work with LabVIEW are simplifying the development of machines, industrial equipment, analytical instruments, and medical devices. ■

John Hanks

Director of Measurement and Control

To learn more about NI measurement-ready OEM capabilities, visit ni.com/info and enter **nsi6304**.

NI M Series Data Acquisition on PXI Express

National Instruments offers the industry’s first PXI Express data acquisition (DAQ) devices – the NI PXIe-6251 and NI PXIe-6259 M Series modules with 16-bit resolution and 1.25 MS/s sampling rates. The modules use new PXI Express technologies, such as a x1 (“by one”) 250 MB/s per-slot dedicated bandwidth bus interface, tighter synchronization, lower latency, and software backward compatibility with existing PXI DAQ applications.

To view the specifications and buy online, visit ni.com/info and enter **nsi6305**.

NI Oscilloscope Offering Extends to 2 GS/s

The NI PXI-5152 general-purpose digitizer/oscilloscope extends the NI digitizer offering to 2 GS/s by providing a 1 GS/s real-time sampling rate on two simultaneous channels or a 2 GS/s rate on one channel.

One Digitizer, Many Applications

You can readily use the National Instruments PXI-5152 digitizer as a full-featured oscilloscope for time-domain measurements. Further, unlike a traditional oscilloscope, you can use software to reprogram the PXI-5152 for custom measurement needs in a broad range of application areas such as semiconductor chip characterization, ultrasonic nondestructive test (NDT), and mass communications.

PXI-5152 features include:

- 1 GS/s real-time sampling rate on two simultaneous channels, or 2 GS/s on one channel
- 20 GS/s equivalent-time sampling (ETS) rate for repetitive signals
- 300 MHz analog bandwidth
- 50 Ω and 1 MΩ input impedance (software-selectable)
- 100 mV to 10 V input ranges
- Up to 512 MB onboard memory for long acquisition times
- Multiple-record mode for retriggered acquisitions
- NI-SCOPE driver software with more than 50 built-in measurement and analysis functions

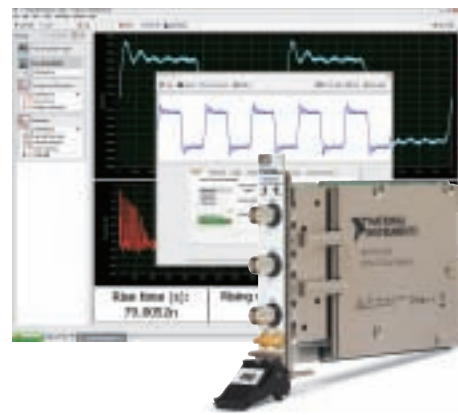


Figure 1. You can readily use the new NI PXI-5152 2 GS/s digitizer as a full-featured oscilloscope and reprogram it in software for custom measurements.

From Benchtop to ATE

By taking advantage of the power of software and the PC, you can use the same digitizer from the benchtop to an ATE system. For example, you can use National Instruments SignalExpress or NI-SCOPE Soft Front Panel software for an out-of-the-box benchtop experience in the design phase of your product development. You can use the same digitizer with existing test code/IP in an ATE system when you combine it with a test

executive software package such as NI TestStand. The included NI-SCOPE driver, which is common to all NI digitizers, works with programming languages such as National Instruments LabVIEW and LabWindows/CVI. The driver also offers compatibility for Express configuration-based functions within NI LabVIEW. Refer to Table 1 for a guide to the broad range of NI digitizers available in single-slot 3U PXI and PCI packages.

A Complete Mixed-Signal Platform

The PXI-5152 digitizer is built on the NI Synchronization and Memory Core (SMC) architecture, which offers deep onboard memory, high throughput, and tight synchronization. SMC-based instruments achieve picosecond-level synchronization accuracy among multiple modules for building high-channel-count systems and creating mixed-signal applications.

Rather than settle for a mixed-signal oscilloscope (MSO) with limited digital functionality, you can use the new PXI-5152 digitizer with arbitrary waveform generators and digital waveform generator/analyzers to build a complete mixed-signal application. Such a mixed-signal platform in PXI not only helps you achieve tight correlation between the analog and digital waveforms but also system expansion in terms of channel count and signal type. ■

To read a white paper on the top things to consider when buying your next digitizer/oscilloscope, visit ni.com/info and enter **nsi6306**.

	8 Bits	12 to 14 Bits	16 to 20 Bits	22 to 24 Bits
5 to 20 GS/s	•	High-Speed Digitizers for Time-Domain Measurements		
2 to 5 GS/s	•	•		
1 to 2 GS/s	•	•	High-Resolution, High-Speed Digitizers for Frequency-Domain Measurements	
200 MS/s to 1 GS/s	•	•		
100 to 200 MS/s	•	•	Industry's Highest-Resolution Digitizers	
15 to 100 MS/s	•	•	•	
1 to 15 MS/s	•	•	•	
Up to 1 MS/s	•	•	•	•

• Indicates Real-Time Sampling
 ◦ Indicates Equivalent-Time Sampling for Repetitive Signals

Table 1. A broad range of NI digitizers/oscilloscopes provides measurement capability from high speed to high resolution. The same NI-SCOPE driver works with all these devices.

Use DDCs for High-Speed RF/IF Streaming

An integral part of many RF/IF communications systems is a digital downconverter (DDC).

To understand the function of the DDC, first look at a typical RF system. This system may involve multiple analog upconversion and downconversion stages that convert the signal from radio frequency (RF) to intermediate frequency (IF) and vice versa. On the acquisition side, the downconverted IF signal is digitized and then demodulated and processed in software.

To understand an area for performance improvement in this scheme, consider the example of recording a 1 MHz signal centered at 40 MHz. This signal could be the result of the analog RF-to-IF downconversion, or it could be the original signal itself. The 40 MHz IF signal is digitized by a 14-bit, 100 MS/s digitizer, resulting in 200 MB/s of data. This far exceeds the bandwidth limitation of PC buses such as PCI, USB, or LAN. Hence, the signal recording length is limited by the digitizer's onboard memory, which permits recording for a few seconds at most.

To digitally record an RF signal for an extended period of time, digital

downconversion offers a solution. In this case, the signal of interest is a 1 MHz narrowband signal, which represents only a small portion of the spectrum. Remember, you need to record only the 1 MHz signal centered around 40 MHz, not the entire Nyquist bandwidth of the analog-to-digital converter (ADC). By multiplying the incoming signal with a numerically controlled oscillator (NCO), which generates a digital sinusoid with a frequency equal to that of the incoming signal (40 MHz in this example) in the FPGA, the DDC effectively shifts the 1 MHz signal of interest to baseband. As with analog downconversion, digital downconversion introduces images, which are then filtered out digitally in the FPGA. Thus far, the downconversion process has moved the signal from IF to baseband, but to realize the benefit of this technique, the digitized waveform, originally sampled at 100 MS/s, needs to be reduced in size. The next step is decimation, in which the digitized waveform is decimated in the FPGA to reduce the effective sample rate to

approximately 2 MS/s. This represents a 50X time improvement in performance and amounts to only 4 MB/s, which you can stream indefinitely over most PC buses.

By focusing on the region of interest, the DDC greatly reduces the data rate so you can stream RF/IF signals continuously. In addition to providing a DDC, some digitizers such as the NI 5142 onboard signal processing (OSP) digitizers leverage the DDC architecture to provide alias-protected decimation for baseband I/Q signals by bypassing the downconversion stage. ■

To learn about a 100 MS/s, 14-bit digitizer with 40 MHz DDC, visit ni.com/info and enter **nsi6307**.

New RF/IF Products for Streaming Applications

NI PXI-5142 and PCI-5142 OSP Digitizers

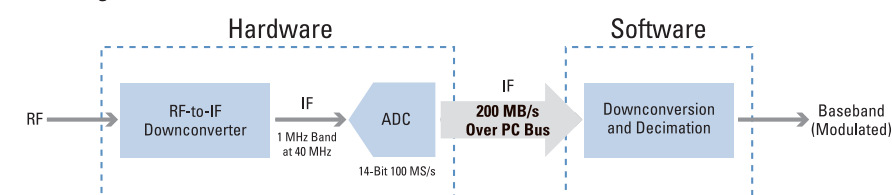
- 100 MS/s, 100 MHz analog bandwidth
- Two simultaneous channels
- 14-bit resolution
- 64 MB or 256 MB/ch
- OSP features, such as:
 - One DDC channel with programmable IF bandwidth up to 40 MHz
 - Baseband I/Q decimation

NI PXI-5661 RF Vector Signal Analyzer

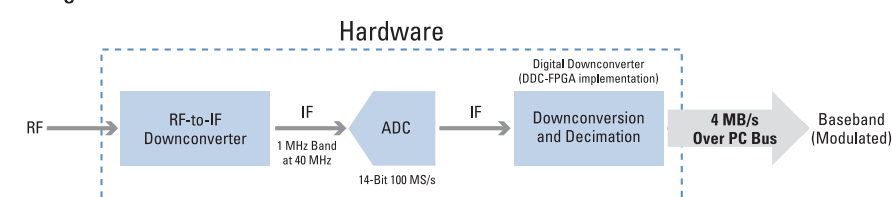
- 9 kHz to 2.7 GHz
- 20 MHz real-time bandwidth, capable of being downconverted to baseband
- 14-bit, 100 MS/s digitizer with onboard digital downconversion included
- Edge/power triggering mode for triggering on signal power level
- Multiple-record mode for retriggered acquisitions

To learn more about the NI PXI-5142 and PXI-5661, visit ni.com/info and enter **nsi6308**.

a. Without Digital Downconverter



b. With Digital Downconverter



The DDC frequency shifts the 1 MHz IF signal centered around 40 MHz down to baseband, thereby reducing the digitizer sample rate requirement from 100 MS/s to 2 MS/s, a 50X improvement in speed.

Students Choose LabVIEW for Signal Processing

Research from the Rose-Hulman Institute of Technology shows that signal processing students prefer NI LabVIEW as a learning tool by a 3 to 1 margin.

Professor Mark Yoder, Ph.D., coauthor of the top-selling textbook *Signal Processing First: A Multimedia Approach*, recently transitioned the signal processing course at Rose-Hulman from The MathWorks, Inc. MATLAB® software to the National Instruments LabVIEW graphical development environment. Rose-Hulman has been ranked the No. 1 undergraduate engineering program for seven consecutive years by *U.S. News & World Report*. This move takes advantage of the intuitive nature of graphical programming and the students' ability to focus on and interact with signal processing concepts.

Dr. Yoder created numerous online interactive LabVIEW simulations for student experimentation and mini-projects that mirror those found in the *Signal Processing First* textbook, which has been adopted by more than 70 schools worldwide and translated into four languages.



Figure 1. A custom subpalette assists students with signal generation and visualization when completing their mini-projects.

Improving the Learning Experience

Dr. Yoder's primary goal was to increase the pedagogical gain through graphical interaction and implementation of concepts. Dr. Yoder did this by converting the course to LabVIEW and measured the success with a student survey at the end of the course.

The survey results showed that students quickly became comfortable with and even

preferred LabVIEW (see Table 1). Most students had no LabVIEW knowledge but found it easier to learn than the MATLAB software by a 4 to 1 margin. Dr. Yoder found similar results when assessing the usefulness of LabVIEW in solving signal processing problems. In general, students preferred LabVIEW as a learning tool by a 3 to 1 margin.

In addition to the survey, Dr. Yoder conducted a concept inventory assessment test to measure students' signal processing knowledge before and after the course. The test results, which show the highest gain ever, along with the survey results, have been published in a paper at the 2006 ASEE National Annual Conference. You can read Dr. Yoder's paper, "A Study of Graphical vs. Textual Programming for Teaching DSP," at the link provided at the end of this article.

Getting Students Started

With the help of his students, Dr. Yoder created interactive signal processing simulations and mini-projects, using both graphical programming and textual math with MathScript in LabVIEW. Students used LabVIEW to implement basic and advanced signal processing algorithms with a custom toolkit created by Dr. Yoder. This toolkit – created using built-in functions, custom VIs, and the new sound card API introduced in LabVIEW 8 – is accessible via a custom

Survey Question	MATLAB	LabVIEW	Either/Neither
Which language did you learn first?	60	3	–
Average number of quarters of experience	2.5	1.1	–
Which language was easier to learn?	11	40	12
Better for Quick Task?	9	47	8
Better for solving signal processing problems?	14	44	6
Which language do you prefer to use?	9 – somewhat 7 – strongly	13 – somewhat 28 – strongly	7

Table 1. Survey results show students' preference toward LabVIEW as a learning tool.



Figure 2. Students remotely explore signal processing concepts using a standard Web browser with lab examples built in LabVIEW.

subpalette (see Figure 1) to aid students with their mini-projects.

Virtual Labs – Hands-On Learning

With live, interactive LabVIEW simulations, students gain hands-on experience from Dr. Yoder's course Web site. These simulations offer students the option to easily revisit concepts and explore theory covered in class and in the textbook (see Figure 2). You can find these resources on the official *Signal Processing First* companion Web site at Rose-Hulman.edu/DSPFirst.

The migration of Dr. Yoder's course to LabVIEW has proven successful at the Rose-Hulman Institute of Technology. Students not only prefer LabVIEW and find it easier to use but also learn signal processing concepts better with it. ■

To read Dr. Yoder's ASEE 2006 paper and discover how you can integrate LabVIEW into your signal processing curriculum, visit ni.com/info and enter **nsi6309**.

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Reduce Test Cost with 8-Channel Oscilloscope

Many test engineers consider using a multiplexed data acquisition setup to reduce test cost. Though using modules with shared analog-to-digital converters (ADCs) or even a switch is a cost-effective way to increase channel count, many applications that require phase coherent analog input channels need the performance of a parallel ADC architecture.

With the new low-cost National Instruments PXI-5105 8-channel digitizer/oscilloscope, you can increase the number of analog input channels while maintaining a low test budget. Starting at \$500 USD; €543; or ¥69,625 per channel, this multichannel digitizer is the lowest price-per-channel digitizer in its class, yet it features a broad set of functionality, including the following:

- 60 MS/s real-time sampling rate on eight simultaneous channels
- 60 MHz analog bandwidth

- 12-bit vertical resolution
- 50 Ω and 1 MΩ input impedance (software-selectable)
- 50 mV to 30 V input ranges
- Up to 512 MB onboard memory for long acquisition times
- Multiple-record mode for retriggered acquisitions
- NI-SCOPE driver software with more than 50 built-in measurement and analysis functions

The NI PXI-5105 digitizer is built on the NI Synchronization and Memory Core (SMC) architecture, which offers deep onboard memory, high throughput, and tight synchronization. SMC-based instruments achieve picosecond-level synchronization accuracy among multiple modules, which makes



You can use the new NI PXI-5105 8-channel, 12-bit, 60 MS/s digitizer to build cost-effective, high-channel-count systems in application areas such as ultrasonic nondestructive test.

the PXI-5105 digitizer ideal for building high-channel-count systems in application areas such as ultrasonic nondestructive test (NDT). ■

To find the right digitizer/oscilloscope for your needs, visit ni.com/info and enter **nsi6310**.

Explore New PXI and PXI Express Products from National Instruments

With two computing engines in one physical processor, a dual-core processor can simultaneously execute two tasks, making it ideal for multitasking environments and multithreaded applications, such as National Instruments LabVIEW. The NI PXI-8105 controller – with a 2.0 GHz Intel Core Duo processor T2500 – improves the performance of multithreaded applications up to 100 percent versus single-core controllers with the same processor clock rate.

To view specifications for the PXI-8105 controller, visit ni.com/info and enter **nsi6311**.

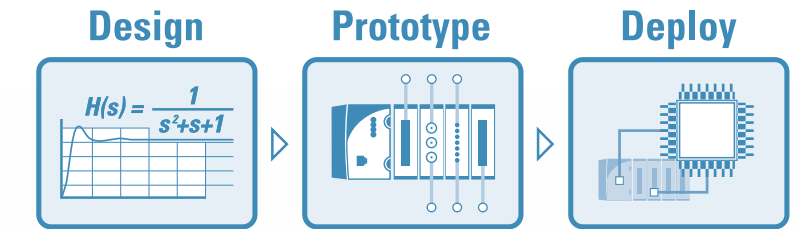
National Instruments also announces its first x4 ("by four") PXI Express dual-core embedded controller (NI PXIe-8105) and x4 NI MXI-Express for PXI Express remote controller (NI PXIe-PCIe837x). The NI PXIe-8105 offers 1 GB/s total system bandwidth and is ideal for multitasking environments and multithreaded applications. The NI PXIe-PCIe837x remote control interface, with a sustained throughput of up to 832 MB/s, is ideal for high-frequency and high-resolution applications requiring maximum sustained bandwidth.

To view the new x4 PXI Express controller specifications, visit ni.com/info and enter **nsi6312**.



NI LabVIEW 8.20 Graphical System Design Platform

National Instruments LabVIEW 8.20 natively integrates multiple application design tools in an open graphical platform. Combine your ideal design approach with integrated I/O to rapidly prototype and deploy your embedded, control, or test system.



Control Design

- Instrument your control design algorithms with interactive user interfaces
- Implement hardware-in-the-loop (HIL) and advanced control on LabVIEW Real-Time platforms
- Connect to The MathWorks, Inc. Simulink® software; Mechanical Simulation CarSim; Dynasim Dymola; Plexim PLECS; and NI MATRIXx

Design

Data flow specifies execution when data is available to a particular function

Interactive configuration-based functions for measurements, filter and control design, and user interface development

Embedded Design

- Deploy to NI RIO FPGAs, DSPs, and 32-bit microprocessors with graphical programming
- Integrate standard embedded tools including Analog Devices Visual DSP++ with C code generation

Electronics Design

- Interactively validate your designs with measurements
- Integrate physical measurements-based input vectors
- Connect to Electronics Workbench Multisim, Ansoft Designer, and SPICE

Deploy

Industrial Control

- Real-time operation and reliability with programmable automation controllers (PACs)
- More than 650 control and analysis functions
- Integrated I/O, motion, vision, and custom I/O capabilities

Mechanical Design

- Validate mechanical and multiphysics simulations with test data
- Map test data directly on 3D CAD/CAE models for easier correlation
- Connect to SolidWorks COSMOSWorks, ANSYS, Nastran, Adams, I-DEAS Pro, Pro/ENGINEER, CATIA, and AutoCAD

Prototype

Communications Design and Test

- Take advantage of hundreds of communications functions with the LabVIEW Modulation Toolkit
- Combine communications functions with modular RF hardware
- Deploy specific solutions including SeaSolve ZigBee, Mindready Universal Radio Tester, and Sumitek Spectral Monitoring

Mathematics

- Bring textual math into LabVIEW with new LabVIEW MathScript
- Explore multiple connectivity options with The MathWorks, Inc. MATLAB® software; Maplesoft Maple; Mathsoft Mathcad; and INRIA Scilab
- Instrument your algorithms with interactive user interfaces and I/O

Third-Party IP

- Take advantage of native digital filter analysis and control capabilities
- Easily integrate VHDL and custom intellectual property (IP) cores with the HDL node
- Include IP from Xilinx, Celoxica, and others

Custom I/O and FPGA

- Custom control or acquisition circuitry with 25 ns timing/trigging resolution
- Based on NI reconfigurable I/O (RIO) technology for ultrahigh performance and customization

MATLAB® and Simulink® are registered trademarks of The MathWorks, Inc.

Object-Oriented Programming in LabVIEW 8.20

You may often hear about the advantages of object-oriented (OO) development as well as terms such as classes, encapsulation, and inheritance. The 20th anniversary edition of National Instruments LabVIEW graphical software, LabVIEW 8.20, adds OO programming to facilitate the development of modular, maintainable, and flexible code.

For example, assume you are testing a circuit board with multiple components.

With LabVIEW 8.20, you can create a class to represent a component, Component.lvclass, and create a VI or method that is part of the class to test the component, TestComponent.vi.

You then can create a class to represent the circuit board, Board.lvclass, which is made up of an array of components. To test your

board, simply call TestComponent.vi on each of the components that constitute a board.

The following example is a simple illustration of how you can use OO development concepts with LabVIEW 8.20. ■

To learn how you can apply object-oriented design by reading an in-depth application note, visit ni.com/info and enter [nsi6313](#).

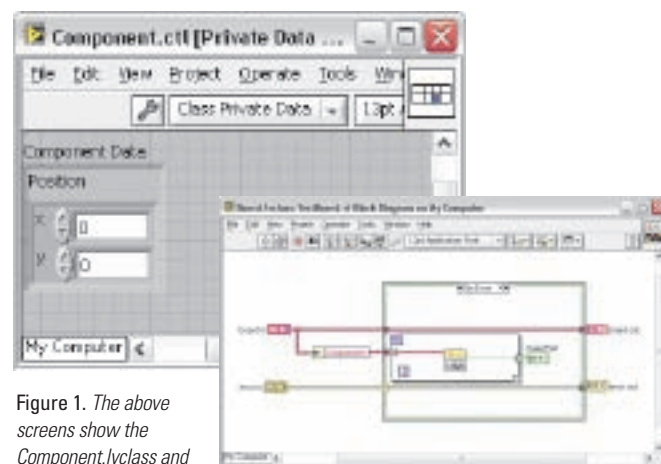


Figure 1. The above screens show the Component.lvclass and its private data.



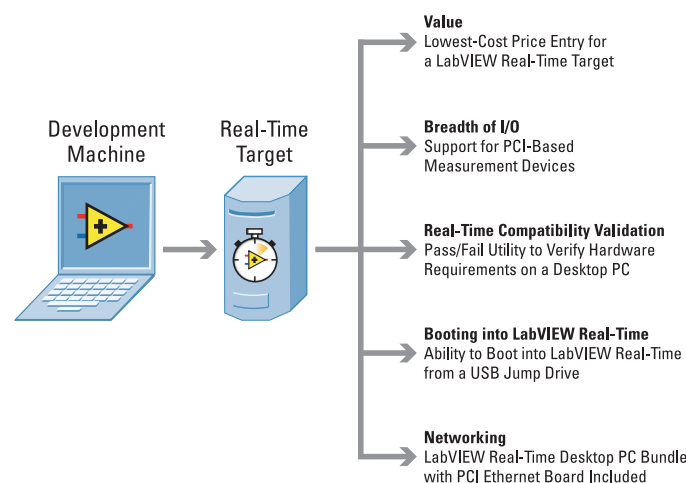
Figure 2. Board.lvclass reuses test code from Component.lvclass.

Use Your Standard PC as a Real-Time System

National Instruments LabVIEW 8.20, the 20th anniversary edition of LabVIEW, introduces new features that easily facilitate the conversion of a standard desktop or industrial PC into an NI LabVIEW Real-Time target. Whether your application requires deterministic timing constraints, increased reliability compared to a general-purpose OS, or autonomous/long-duration operation, using a desktop PC as a LabVIEW Real-Time target can further reduce the cost of achieving a reliable and deterministic system.

The first step is to validate if a PC can become a LabVIEW Real-Time target by running a FREE downloadable utility that verifies hardware specifications. Then, by purchasing a real-time deployment license from National Instruments, you can take a standard PC that meets a specific list of requirements and boot the system into a real-time OS running LabVIEW. Additionally, you can purchase the Real-Time Desktop PC Bundle to further streamline the process of

selecting a compatible PC. This bundle includes both the real-time deployment license and a PCI Ethernet board for network connectivity that is compatible with LabVIEW Real-Time. After you configure the LabVIEW Real-Time target, you can quickly program access to measurements because the majority of NI PCI hardware is supported on real-time desktop PC targets, including M Series multifunction data acquisition devices, R Series FPGA-based intelligent data acquisition devices, and high-performance modular instruments. ■



Desktop PCs add to the existing line of NI LabVIEW Real-Time targets, which include Compact FieldPoint, PXI, CompactRIO, and Compact Vision System.

To view the tutorial, "Converting a Desktop to a LabVIEW Real-Time Target," visit ni.com/info and enter [nsi6314](#).

Inside the New USB M Series DAQ Devices



NI signal streaming technology delivers unprecedented throughputs to NI M Series DAQ devices for USB.

National Instruments M Series multifunction data acquisition (DAQ) devices deliver an extensive set of features that make them ideal for fast, accurate analog and digital I/O. Built on the same technologies that boosted the popularity of PCI and PXI M Series plug-in DAQ devices, the new NI M Series DAQ devices for USB provide more performance, I/O, and value

than other USB data acquisition devices. M Series uses NI-MCal technology, a revolutionary design for calibration at every input range that improves measurement accuracy by up to five times. The NI-PGIA 2 family of programmable gain instrumentation amplifiers dramatically reduces settling time to ensure accurate measurements even at the fastest scanning rates. In addition, M Series DAQ devices offer up to 32 16-bit analog input channels at 1.25 MS/s, four 16-bit analog waveform outputs at up to 2.8 MS/s, two 32-bit counter/timers, and 48 digital I/O lines (32 clocked at up to 1 MHz).

The new USB M Series DAQ devices also incorporate NI signal streaming technology, which optimizes data transfers to and from the PC across a standard USB cable. NI signal streaming technology adds intelligence to the

device, making samples available to you as soon as they are acquired and improving single-point acquisition rates by up to 1,600 percent. (See page 28 for more information about NI signal streaming technology.) The core of each USB M Series device is the newly designed NI USB-STC 2 synchronization and timing controller, which delivers up to 8 MS/s over USB. The NI USB-STC 2 adds NI signal streaming technology to the NI-STC 2 timing engine used on plug-in M Series devices to allow up to four operations to execute simultaneously at rates five times faster than with previous USB data acquisition devices. ■

To see complete specs on NI M Series DAQ devices for USB, visit ni.com/info and enter [nsi6315](#).

Isolated DAQ Devices Deliver Safety, Accuracy

National Instruments recently extended its high-performance isolated multifunction data acquisition (DAQ) offering with 12 new multi-function I/O M Series and simultaneous sampling S Series devices for PCI and PXI. All of these new devices offer high-performance timing, calibration, and amplification circuitry for accurate measurements and, for the first time, allow direct connectivity to ±20 mA current and 24 V digital sensors and actuators with no need for additional signal conditioning.

Isolation provides many safety and accuracy benefits, including:

- Safety from transient voltages
 - Improved immunity from ground noise
 - Common-mode voltage rejection
 - Ground-loop removal
 - Direct connectivity to valves, flow meters, proximity sensors, encoders, and relays
- Isolated M Series devices, used with deterministic National Instruments LabVIEW 8.20 Real-Time software, offer a low-cost and reliable solution for industrial control and monitoring applications such as process control, discrete manufacturing, packaging, automotive testing, fuel-cell testing, and more. All of these new devices

integrate seamlessly with NI LabVIEW 8.20, and you can configure them with NI-DAQmx driver and measurement services software. NI also offers driver support for isolated M Series devices on various OSs, including Windows, Macintosh, Linux*, and the LabVIEW Real-Time Module running on a real-time OS. ■

To watch a three-minute tutorial on how your application can benefit from isolated data acquisition, visit ni.com/info and enter [nsi6316](#).

Linux* is a registered trademark of Linus Torvalds in the U.S. and other countries.

Product	Bus	Analog I/O 16-Bit, 260 KS/s	Digital I/O 6 IN, 4 OUT	Sinking/Sourcing Digital Outputs	Isolation
NI 6154	PCI	4 IN (±10 V), 4 OUT (±10 V) simultaneous	5 V TTL	Sink/Source	✓ (Channel-to-Channel)
NI 6230	PCI/PXI	8 IN (±10 V), 4 OUT (±10 V)	5 V TTL	Sink/Source	✓
NI 6232	PCI/PXI	16 IN (±10 V), 2 OUT (±10 V)	24 V	Source	✓
NI 6233	PCI/PXI	16 IN (±10 V), 2 OUT (±10 V)	24 V	Sink	✓
NI 6236	PCI/PXI	8 IN (±20 mA), 4 OUT (0 to 20 mA)	5 V TTL	Sink/Source	✓
NI 6238	PCI/PXI	16 IN (±20 mA), 2 OUT (0 to 20 mA)	24 V	Source	✓
NI 6239	PCI/PXI	16 IN (±20 mA), 2 OUT (0 to 20 mA)	24 V	Sink	✓

Isolated M and S Series devices offer isolation, ±20 mA current, and 24 V digital input and output channels.

Frame Grabbers for IEEE 1394, Camera Link

At the NIWeek 2004 conference, National Instruments demonstrated the world's first PCI Express frame grabber, which acquired images at 680 MB/s. Since then, engineers and scientists have discovered that PCI Express is a useful technology for more than just high-speed imaging. For example, applications that use multiple cameras can easily overrun the 100 MB/s barrier set by the older PCI bus. Because each PCI Express frame grabber has its own dedicated bus, many cameras can run in parallel without concern for PC bus bottlenecks.

NI has announced two new frame grabbers based on PCI Express that pair the new capabilities of PCI Express with the two most common digital camera buses – IEEE 1394 and Camera Link. The National Instruments PCIe-8255R combines an IEEE 1394 host adapter with industrial digital I/O,

so you can trigger and synchronize multiple IEEE 1394a or IEEE 1394b cameras without purchasing additional digital I/O or building custom circuitry. In addition, the National



New PCI Express frame grabbers work with Camera Link and IEEE 1394 cameras.

Instruments PCIe-1427 is a new, general-purpose frame grabber that can acquire images from any base-configuration Camera Link camera.

You can use the industrial digital I/O lines on both the NI PCIe-8255R and the NI PCIe-1427 to synchronize vision components such as cameras, triggers, and lights. In addition, you can access quadrature encoder inputs, pulse generation lines, and general-purpose isolated digital I/O for communicating with actuators, programmable logic controllers (PLCs), and NI programmable automation controllers (PACs). ■

To learn how PCI Express is shaping the future of vision and to download the PCI Express Vision e-Kit, visit ni.com/info and enter **nsi6317**.

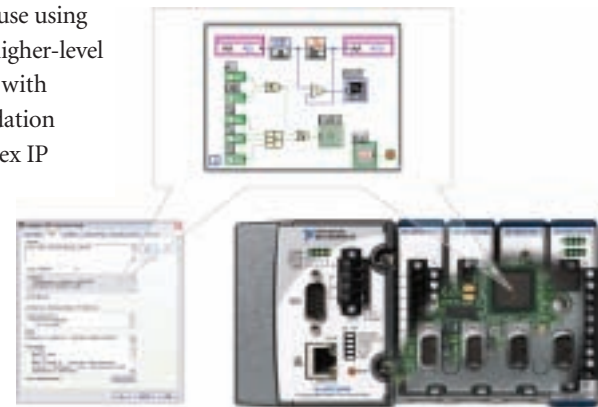
IP for FPGA Hardware – Build or Buy?

In the embedded world, the term “intellectual property (IP) block” refers to a set of reusable code for hardware logic design. Third-party companies sell many useful IP blocks for applications such as digital signal processing (DSP), peripheral bus interfacing, image processing, and wireless protocol implementation. Some vendors even provide tools to help you translate C algorithms into hardware description language (HDL) code, which you can then incorporate into the National Instruments LabVIEW FPGA Module with the HDL interface node. Once imported, you can test the algorithm with real-world sensor and actuator signals on an FPGA-based embedded prototyping platform, such as the NI CompactRIO platform.

In recent years, the power and performance of NI LabVIEW graphical programming tools for FPGA design have increased rapidly, causing developers to consider

building their own IP blocks in-house using native LabVIEW code. By using a higher-level graphical programming language with built-in algorithm design and validation tools, you can take on more complex IP projects. Additionally, your code executes in a functionally equivalent manner, regardless of the processing target, so you can test LabVIEW FPGA IP blocks before compilation using simulated signals and the enhanced debugging tools in LabVIEW for Windows.

Whether you decide to build or buy the IP for your next project, NI graphical system design tools can help you design, prototype, and deploy your system faster. ■



Using the NI LabVIEW FPGA Module and CompactRIO, you can import third-party IP and quickly prototype your design with real-world signals.

To learn more about creating your own IP blocks or importing HDL code into the LabVIEW FPGA Module, visit ni.com/info and enter **nsi6318**.

Enhanced C Code Integration with LabVIEW 8.20

Over the last 20 years, National Instruments LabVIEW has become one of the most popular software environments for creating instrument control applications.

Much of this popularity can be attributed to the broad availability of NI LabVIEW instrument drivers, which provide consistent, high-level interfaces that simplify instrument programming tasks. The 20th anniversary edition of LabVIEW, LabVIEW 8.20, continues instrument control innovation with new tools that make it easier to use drivers for third-party instrumentation as well as LabVIEW drivers in C programming environments.

DLL Import Wizard

In the absence of LabVIEW drivers or a published messaging interface, LabVIEW programmers have had to rely on calling

compiled shared libraries through the Call Library Node. The new DLL Import Wizard simplifies this process by automating the creation of a LabVIEW project library that encapsulates each shared library function call into its own separate VI.

Compatible with multiple OSs, the wizard works with most Windows DLLs, Macintosh .framework files, and Linux OS shared objects, as long as they have an accompanying C-based header file. Once loaded into the wizard, LabVIEW examines the header files and eliminates much of the tedious work of determining the appropriate LabVIEW data types to pass into each exported function. Finally, you can use the tool to add any other documentation or modify any of the inputs or outputs before generating the appropriate LabVIEW VIs. Upon completion, you can immediately use the resulting LabVIEW project library and VIs in your own LabVIEW code. If at any time it becomes necessary to modify the library, the wizard remembers the previous settings so you can easily modify and regenerate code.

Instrument Driver Export Wizard

Develop your LabVIEW Plug and Play instrument drivers in LabVIEW and use them in C with the new Instrument Driver Export Wizard. Taking advantage of the



Figure 2. The DLL Import Wizard simplifies the use of instrumentation that does not include LabVIEW Plug and Play drivers.

improved organizational structure of LabVIEW project-style instrument drivers in LabVIEW 8.20, the tool automates the creation of a C interface based on the *VXIplug&play* standard. With new time-saving features, the Instrument Driver Export Wizard:

- Constructs LabVIEW DLLs with C-specific header files and data types.
- Creates fully documented CVI function panels (.fp) using VI and control documentation.
- Automatically converts much of the documentation into C terminology. For example, it replaces specific LabVIEW words, such as “VI” with “function.” ■

To read a white paper on using the DLL Import Wizard, visit ni.com/info and enter **nsi6319**.

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Figure 1. The Instrument Driver Export Wizard creates C programming interfaces for your LabVIEW Plug and Play instrument drivers.

FREE Instrument Control Fundamentals Series

USB? LXI? PXI? Confused about the latest technologies for instrument communication? The NI Instrument Control Fundamentals Series is your FREE technical resource for setting up instrumentation systems. Covering the latest communication bus and software technologies, this series of comprehensive tutorials and multimedia presentations provides a step-by-step guide to walk you through the process of connecting and controlling your instruments.

To view the FREE series, visit ni.com/info and enter **nsi6320**.

LEGO® and NI Create LEGO MINDSTORMS® NXT

The LEGO Group and National Instruments have collaborated to develop the next generation of LEGO MINDSTORMS robotics. LEGO MINDSTORMS NXT includes a new intuitive software environment powered by National Instruments LabVIEW graphical development software. The new software combines the best ideas from previous versions with the latest graphical programming technologies to make the software easy to use and more intuitive than ever.

The relationship between the LEGO Group and NI began in 1998 with the development of ROBOlab, the programming software behind the original LEGO MINDSTORMS for Schools. ROBOlab software, developed

in collaboration with the Tufts Center for Engineering Education Outreach, is also based on NI LabVIEW and has helped make LEGO MINDSTORMS for Schools a leading robotics learning and invention system for educators worldwide.

Empowering Children to Program with LabVIEW

When National Instruments introduced LabVIEW in 1986, its goal was to empower engineers and scientists who had little or no programming background to create their own measurement and automation systems. Twenty years later, NI continues to expand LabVIEW with a new version that is available to children worldwide through LEGO MINDSTORMS NXT software. MINDSTORMS NXT software is based entirely on LabVIEW, with a new user interface designed specifically for children. Many of the core LabVIEW features are preserved so children and adults can take full advantage of the product features. Familiar features include the case structure, while loop, blocks similar to Express VIs, and the critically important “Create My Block” – analogous to the Create SubVI feature.

Collaborative Development Process

A major part of the joint development has been the close contact with both the MINDSTORMS and LabVIEW user communities. Shortly after the MINDSTORMS NXT announcement, LEGO launched the MINDSTORMS Developer Program (MDP) to drive consumer feedback on the product. Four of the MDP members are also members of the NI LabVIEW Champions program, a group of outstanding members of the global LabVIEW community.



Figure 2. LEGO MINDSTORMS NXT software, based on NI LabVIEW, is an intuitive, feature-rich programming environment for building and programming robots.

LabVIEW Toolkit for LEGO MINDSTORMS NXT Announced

At the NIWeek conference, which begins August 8 in Austin, Texas, LEGO and NI are jointly announcing the availability of a pioneer version of the LabVIEW Toolkit for LEGO MINDSTORMS NXT. With the toolkit, LabVIEW users can program MINDSTORMS NXT systems, and developers of add-on NXT hardware, such as sensors and actuators, can create blocks for MINDSTORMS NXT software.

LEGO MINDSTORMS NXT Availability

LEGO MINDSTORMS NXT is available in North America beginning August 1, with international availability to follow later this year. You can purchase online from LEGO and in stores including Apple; Best Buy; Target; and Toys “R” Us, Inc. Educators can purchase MINDSTORMS Education from LEGO Education. The educational version of MINDSTORMS NXT features the same software, based on LabVIEW, and includes curriculum specifically for educators. ■

For more information on how to purchase LEGO MINDSTORMS NXT, visit ni.com/info and enter **nsi6321**.

Searching on ni.com Just Got Easier

More than ever, search engines are helping people find the most relevant, timely information online.

Search on the National Instruments Web site is no exception. The next time you visit ni.com, check out recent updates to the Search Results page to help you search more effectively. Key changes include the following features:

- **Narrow Your Results Navigation** – This new feature displays the sections on ni.com that contain content related to your search term. For example, if you search on a broad keyword such as “LabVIEW embedded,” the search engine returns results in all categories on ni.com, including the Products and Services, Support, Academic, Events, NI Developer Zone, and Company sections. However, if you only want content related to LabVIEW embedded support, you can narrow your search results by clicking on the Support category. This action removes all the content that resides in other areas of the site to only show you items in the Support category, such as product manuals, tutorials, and example code (see Figure 1).
- **Related Searches Display** – Based on the documents your search returns, the search engine suggests related terms below the search query box. The related search terms are clickable links that perform a new search on the similar word(s). These values are determined by the most common words found in the documents returned from the

original search. Therefore, you quickly can find related content using terms you may not have initially considered.

- **Spell-Check Function** – Occasionally, you may misspell words when performing a search. When this happens, ni.com now suggests the correct spelling. This suggestion is a clickable link that executes another search on the correctly spelled word (see Figure 2).
- **Customized RSS Feeds** – With Really Simple Syndication (RSS), you can monitor content updates and additions from your computer desktop instead of revisiting a site. On every ni.com search result page, an orange RSS button appears next to the number of results displayed. Once you click on the RSS button, the search results convert to a format that an RSS reader installed on your computer can understand, thereby directly feeding the relevant content to you. This feature gives you complete control over what you receive in the RSS feed. Data acquisition tutorials, events in Germany, or new modular instrument product releases are a few examples of potential targeted feeds you can create using the search RSS feature. ■

Explore these new features on ni.com today. For more information on NI RSS feeds, visit ni.com/info and enter **nsi6322**.



Figure 1. Easily narrow your ni.com search results to the exact content you are looking for with the new sidebar navigation.



Figure 2. Spell-checking is now automatically available on search query terms, giving you a convenient way to correct your search.

Find New RoHS Information Online

National Instruments now offers a Web site with information on its new Hazardous Substance Reduction Initiative environmental program. The NI initiative is a voluntary program modeled after the European Parliament’s RoHS directive, which restricts the use of certain harmful substances such as lead, mercury, and cadmium. The site lists compliant products and plans for future compliance.

For more information on RoHS compliance, visit ni.com/info and enter **nsi6323**.

80 Channels with μ s Settling, μ V Accuracy

The new NI 6255 high-speed M Series data acquisition (DAQ) devices extend the data acquisition standard with 80 16-bit analog input channels at 1.25 MS/s maximum sampling rates. NI 6255 devices are the fastest high-channel-count DAQ devices offered by National Instruments and feature microsecond settling time and microvolt accuracy.

To view the specifications and buy online, visit ni.com/info and enter **nsi6324**.

Figure 1. A 32-bit processor, Bluetooth wireless communication, intelligent sensors and motors, and NI LabVIEW graphical development software provide leading technology for the new LEGO MINDSTORMS NXT.

Embedded Drivers for Linux®, QNX, VxWorks

Although data acquisition I/O vendors invest hundreds of man-years developing high-quality, easy-to-use driver software, sometimes embedded system developers need even more flexibility.

For example, an embedded system may require a minimum installed footprint or use a “nonstandard” OS, or embedded developers may require development tools to create I/O drivers other than those optimized for the large customer segment using Microsoft Windows. To offer embedded system developers flexibility when adding I/O to their choice of embedded hardware and OS, National Instruments provides the NI Measurement Hardware DDK (Driver Development Kit).

NI Measurement Hardware DDK Architecture Overview

The NI Measurement Hardware DDK delivers a register-level programming interface for developing custom driver software on many OSs commonly used in embedded applications including Linux, QNX, and VxWorks. It provides access to the full device register maps and offers examples for completing common measurement and control functions. The NI Measurement Hardware DDK works with a selection of multifunction, analog output, digital I/O, and counter/timer I/O devices, including National Instruments M Series, E Series, and S Series multifunction data acquisition (DAQ) devices.

The Measurement Hardware DDK architecture consists of three main layers – the register-level programming (RLP) examples, the ChipObject, and the osiBus.

Register-Level Programming Examples

The RLP examples implement application-specific operations on a specific board or

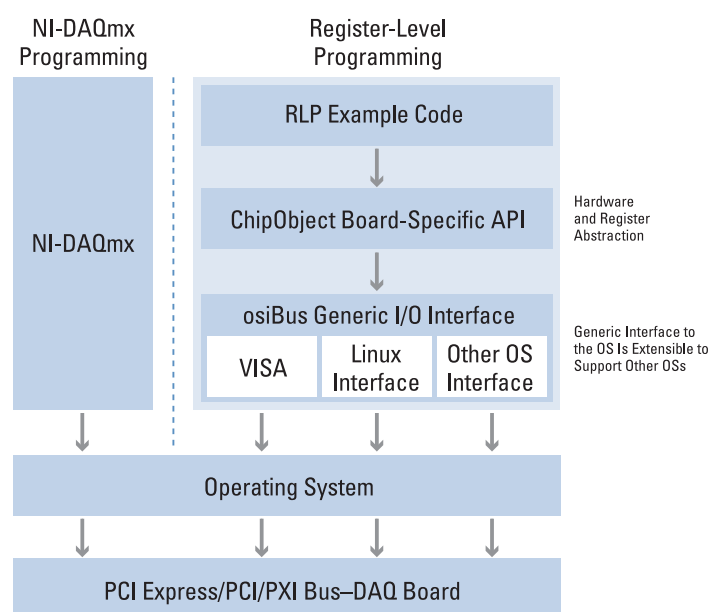
hardware, such as single-point analog input from an NI E Series I/O device. Each example illustrates how to program a specific operation using the general functionality of the ChipObjects. Developers easily can adapt these examples, which illustrate the general use of the ChipObject for other operations.

ChipObjects

Depending on their availability for specific hardware types, ChipObjects abstract low-level register access by providing objects and methods using logical names for the registers and bit fields on the hardware. While not as easy to use as NI-DAQmx driver software, ChipObjects greatly simplify register-level programming and eliminate many common errors. In addition, ChipObjects remove other difficulties such as windowed register access. Because ChipObjects are based on the osiBus layer, they also eliminate the need for memory mapping.

osiBus

The operating system interface bus (osiBus) layer is a generic register I/O interface used by ChipObjects to interface to hardware. The osiBus interface to ChipObjects is consistent for all OSs and platforms. The osiBus contains OS- and platform-specific



Use the NI Measurement Hardware DDK with the OS of your choice to easily add I/O to your embedded system.

implementations so it can interface to the hardware on the chosen platform. Therefore, developers can port the osiBus by reimplementing this OS-specific layer. This process is described in more detail in Measurement Hardware DDK resources available on ni.com.

NI Driver Options Offer Flexibility

NI-DAQmx driver software provides a high-performance, reliable, and easy-to-use interface for programming I/O hardware. However, in cases that require further flexibility, National Instruments offers Measurement Hardware DDK as a register-level programming option for development on many embedded OSs, including QNX, VxWorks, and Linux. ■

To download the NI Measurement Hardware DDK (Driver Development Kit), visit ni.com/info and enter [nsi6325](http://ni.com/info).

Linux® is a registered trademark of Linus Torvalds in the U.S. and other countries.

Daewoo Servo Motion Control System for HDDS

By Byoungbok Kang, Daewoo Electronics

The Challenge: Overcoming the technological limitations of traditional 2D storage devices to achieve greater capacity and faster data retrieval.

The Solution: Developing the world's first servo motion control system for 3D holographic digital data storage on continuous rotation disks using the National Instruments LabVIEW FPGA Module and CompactRIO.

Traditional data storage technologies, which store individual bits of information as magnetic or optical variations on the surface of the medium, are approaching physical limits. However, holographic digital data storage (HDDS) promises to accelerate data transfer rates to about 1 billion bits per second, reduce access times to just

tens of microseconds, and increase storage densities toward a theoretical maximum of 1 trillion bits per cubic centimeter.

The Daewoo HDDS prototype consists of two main subsystems – an electro-optical motion control system based on the NI CompactRIO 3M gate FPGA series and a video decoding system. The CompactRIO system controls a linear motor, a stepper motor, a galvo mirror, and a CMOS camera. Each motion control loop requires precise control, so we use feedback signals to control and detect data. Unlike a traditional computing board, with CompactRIO we can customize pulse generator timing to the resolution of a single FPGA clock using the NI LabVIEW FPGA Module. The system performed reliably during demonstrations at the 2005 Korea Electronics Show (KES), without any communication or operational errors among devices and boards, giving us a



Daewoo Electronics developed a holographic storage device using NI LabVIEW FPGA and CompactRIO.

demonstrable technological edge in the emerging field of HDDS. ■

To read the full-length customer solution, visit ni.com/info and enter [nsi6326](http://ni.com/info).

LabVIEW Measures Channel Tunnel Condition

By Gerard Delacre, Eurotunnel, and Veronique Newland, New Vision Technologies, Inc.

The Challenge: Measuring wear on the electrical contact cabling inside the European Channel Tunnel without disrupting traffic.

The Solution: Using National Instruments LabVIEW, the Vision Development Module, and the Compact Vision System to design an embedded imaging process capable of taking accurate optical measurements quickly and without interrupting service.

In 2004 alone, more than 16 million rail passengers traveled through the European Channel Tunnel. We required a method to measure the wear on the 100 km of electrical contact cabling inside the tunnel without disrupting rail traffic, in addition to

simultaneously measuring the position, height, and width of the contact wear on the cable. We met both of these challenges using NI LabVIEW, the NI Vision Development Module, and the NI CVS-1454 compact vision system.

With LabVIEW and the Vision Development Module, our engineers developed and tested the processing software on a PC-based Windows platform using a library of images previously recorded in the tunnel. We could then easily transfer the same code to the embedded CVS-1454.

LabVIEW and the Vision Development Module also make it easy to update the image processing software on the CVS-1454. For example, adding image logging to record special faults or anomalies on the cabling was very straightforward. Also, with the modular hardware and software approach, we can add



The Channel Tunnel uses NI LabVIEW software and vision products to measure more than 100 km of electrical cabling.

more compact vision systems in the future to measure and inspect other elements of the infrastructure, such as dropper points, rail, and track geometry. ■

To read the full-length customer solution, visit ni.com/info and enter [nsi6327](http://ni.com/info).

New On-Demand Training from NI

National Instruments recently introduced new benefits for the Standard Service Program (SSP) and Premiere Service Program (PSP). These new resources make it easier than ever to stay current with the latest software releases and access resources designed to help ensure your success with NI products. Membership in the SSP and PSP includes the following benefits:

- On-demand training
- Services Resource Center access
- Software upgrades and maintenance releases
- Technical support via phone and e-mail

Grow Your Skills through On-Demand Training

Created exclusively for members of SSP, PSP, and the Training Membership program, on-demand training courses and curriculum deliver a structured, high-quality learning experience that addresses all ability levels. On-demand training extends knowledge acquired in classroom-based courses, such as LabVIEW Basics and Data Acquisition and Signal Conditioning courses. Modules range from five minutes to 20 minutes and cover beginner- to advanced-level topics.

National Instruments adds new on-demand training courses on a monthly basis that cover a wide variety of NI products; you

also can download the courses via the Services Resource Center.

Visit the Services Resources Center

Visit the Services Resource Center at ni.com/services to stay current with the latest updates for your software.

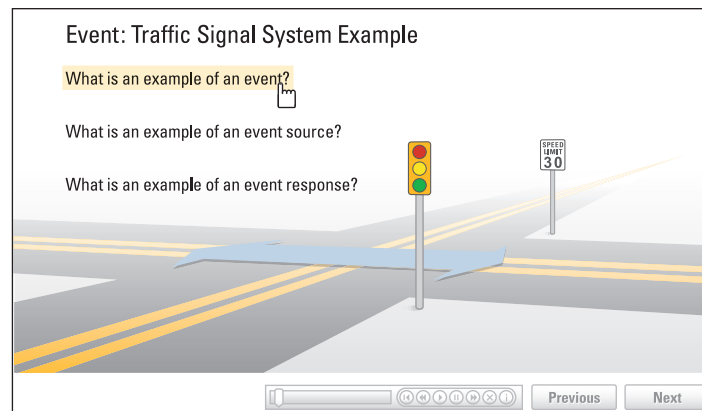
Here, you can

download software maintenance releases or request a CD delivery of the release.

The portal also is your easy access point for on-demand training and other beneficial material included in your SSP and PSP membership.

Stay Current with the Latest Software Upgrades and Maintenance Releases

Through your membership, you receive updates for software packages purchased with SSP and PSP. These updates include major upgrades as well as maintenance releases and documentation changes. National Instruments ships major upgrades to you immediately following release. In addition, NI informs you



On-demand training provides a convenient online resource to develop your software skills.

of new updates and makes them available for download through the Services Resource Center.

Find Help through Online, Phone, and E-mail Technical Support

Tap into the knowledge of hundreds of technical NI applications engineers via phone and e-mail. In addition, take advantage of active discussion forums and an extensive library of technical support information such as the NI KnowledgeBase, example programs, and tutorials at ni.com/support.

To begin exploring your new SSP and PSP benefits today, visit ni.com/info and enter **nsi6328** or call **(800) 531 5066**.

Learn LabVIEW Architectures in New Advanced Course

Have you ever wondered about the best LabVIEW architecture for your application or how advanced LabVIEW features can reduce your development time?

The new National Instruments LabVIEW Advanced I: Architectures course addresses these topics and gives you the opportunity to learn application design from expert Certified LabVIEW Architects. This course:

- Introduces common practices for managing large, team-oriented application development projects from specification to deployment
- Teaches you advanced LabVIEW features, such as XControls and custom Express VIs, and how to select and develop templates, architectures, and design patterns recommended for large LabVIEW applications
- Provides hands-on application of design concepts through exercises and projects
- Develops the skills you need to effectively manage and implement large LabVIEW applications in multideveloper environments

To view a course outline or to register, visit ni.com/info and enter **nsi6329**.

Portable, USB-Powered m+p Real-Time Analyzer

National Instruments Alliance Partner m+p international introduces the SmartOffice (SO) Analyzer USB4, equipped with a 4-channel, USB-powered dynamic acquisition module. The SO Analyzer USB4 is ideal for noise and vibration applications in automotive, aerospace, military, and other industrial environments, providing highly accurate measurements from audio frequency IEPE sensors and all the necessary functionality at a low cost.

You can easily load the SO software, connect the NI USB-9233 dynamic signal acquisition module using the USB cable, and start measuring with the IEPE sensors powered directly from the USB port. With 25 kHz bandwidth, 24-bit resolution, and 102 dB dynamic range, the SO Analyzer USB4 offers high precision on four or more channels and is well-suited for versatile noise and vibration measurements.

The intuitive user interface and wizard-driven setup ensure quick and safe operation, minimizing the probability of operator error. The flexible real-time



With its self-powered Hi-Speed USB4 connectivity to a host PC or a laptop, the SO Analyzer is ideal for both field and laboratory applications.

acquisition features user-selectable block sizes, sample rates, filtering, and resampling as well as a wide range of time- and frequency-domain computed functions and averaging modes.

The SmartOffice e-Reporter centrally manages all data, so you can browse, view, rescale, analyze, and organize measurements. Within the same user interface, you can perform operating deflection shape (ODS), modal, rotating machinery, and acoustics analyses without transferring data to another package. You also can generate reports either in bitmap format or with ActiveX graphics to embed graphs in Microsoft Word documents using the FREE SmartOffice Viewer software add-on for Microsoft Office. ■

To download FREE SmartOffice demonstration software, visit ni.com/info and enter **nsi6330**.

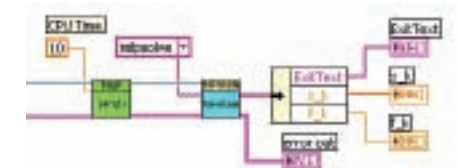
Optimize LabVIEW with TOMVIEW

NI Alliance Partner Tomlab Optimization Inc. introduces TOMVIEW, a set of advanced solutions for scheduling, production planning, global parameter estimation, and design optimization for National Instruments LabVIEW software. TOMVIEW is powered by high-quality optimization engines that have seen growing adoption among end users needing to generate optimal decisions for their technologies. TOMVIEW is available in a variety of solver packages, including:

- **TOMVIEW Base Module** – advanced curve-fitting with a variety of objectives as well as mixed-integer linear and nonlinear optimization
- **TOMVIEW/SNOPT** – large-scale sparse quadratic and nonlinear decision optimization suitable for constrained process control

- **TOMVIEW/NPSOL** – large-scale dense curve-fitting (least squares)
- **TOMVIEW/CPLEX** – mixed-binary/integer package designed for scheduling, transportation, planning, and general process problems
- **TOMVIEW/LGO** – global design optimization

The TOMVIEW system covers virtually all areas of optimization in a fully integrated platform. Sparse matrix handling is implemented systemwide for optimal speed and memory handling. With sparse matrix handling in the Base Module, you can perform a new range of large-scale linear algebra calculations for NI LabVIEW with great reductions in computational time. Using a sparse format, you can essentially eliminate the matrix size limitation in LabVIEW.



You can easily control all TOMVIEW solver settings from LabVIEW by inserting blocks from the solver user palettes.

The streamlined TOMVIEW solution process reduces advanced prototype development time. The procedure is the same – Assign-Modify-Solve – regardless of the problem type. More than 400 test cases for solver testing are included to save you time, and the solver-independent design will protect your investment for years to come. ■

To obtain a FREE demonstration license, visit ni.com/info and enter **nsi6331**.

Freescale, Alliance Partner CompactRIO Modules

Freescale and National Instruments Alliance Partners S.E.A. Datentechnik, AviaOk International, and Drivven have developed modules that add functionality to the NI CompactRIO platform for in-vehicle, automotive, aerospace, and distributed applications.

Freescale developed a local interconnect network (LIN) module for integrating CompactRIO into low-cost LIN automotive buses for designing, prototyping, and testing LIN electronic control units (ECUs). Wireless and mobile modules from S.E.A. perform global positioning system (GPS) monitoring

and global system for mobile communications/general packet radio service (GSM/GPRS) wireless communication for CompactRIO systems. AviaOk created avionic protocol modules such as the ARINC-429 and MIL-1553 for use in CompactRIO in-flight acquisition and control applications. Vehicle design and prototyping modules from Drivven provide direct connection to automotive and vehicle sensors for quickly designing and prototyping a variety of vehicle ECUs. ■

To obtain a complete list of third-party CompactRIO modules, visit ni.com/info and enter **nsi6332**.



The S.E.A. Gxxx Combo Module includes both wireless GSM and GPS functionality.

GÖPEL Boundary Scan, MOST Bus for PXI Express

Select NI Alliance Partner GÖPEL electronic recently introduced a new series of JTAG/ Boundary Scan PXI Express interface controllers as part of the SCANFLEX Boundary Scan hardware platform as well as a new MOST Bus communication module for automotive ECUs based on the PXI Express and PCI platforms.

compensation and HYSCAN for dynamic splitting of serial test access port (TAP) vectors and parallel I/O vectors.

The new controllers also feature pre-converted software plug-in modules for integration with National Instruments LabVIEW, NI TestStand, and LabWindows/CVI software.

MOST Bus

The GÖPEL PXIe/PCI 3060 supports the MOST Bus with full compliance to the current specification, particularly addressing general test and measurement communication applications and vehicle control units. The module is both master- and slave-configurable. It also features a single MOST Bus interface, an audio input channel, and an audio output channel. Future applications will support standard functions such as control channel, packet channel, and streaming channel, as well as data monitoring via the MOST Bus and diagnostics via MHP (MOST High Protocol). ■



With the new GÖPEL SCANFLEX controller, you can perform JTAG/Boundary Scan on PXI Express.

To learn more about SCANFLEX for JTAG/Boundary Scan, visit ni.com and enter **nsi6333**.

NI Technical Symposium Offers New Content

Redesigned for 2006, the NI Technical Symposium Professional Development Series for Engineers offers productive engineering tools and the latest technology to give you and your company a clear competitive advantage.

Visiting 28 cities in North America, the symposium is designed to help engineering professionals increase their knowledge base and expertise in the test, measurement, and control arena. They do this through basic, intermediate, and advanced technical sessions as well as hands-on demonstrations on leading technologies and emerging industry trends. With an open agenda format through which you can choose your topics of interest and customize your learning experience, the symposium can help you find new ways to address your custom engineering challenges.

Attend this event to stay current on the latest engineering tools and technologies and learn how to maximize your investment in National Instruments tools. Take advantage of:

- Technical content for both new and advanced users

- Hands-on sessions to help build application development expertise
- Networking opportunities with colleagues, vendors, and industry experts
- One-on-one time with local field engineers
- Real-life solutions and new product demonstrations

Stay competitive by adding more value to your career and your company through knowledge of the latest tools and trends. ■

To register and confirm dates for the NI Technical Symposium Professional Development Series for Engineers, visit ni.com/info and enter **nsi6334**.

Register Early for NIWeek 2007 and Save

Register by November 1 for NIWeek 2007, August 7-9, and receive on-site registration discounts on full-conference passes and exhibition space. If you missed NIWeek 2006, visit ni.com/niweek to view daily keynotes, learn about the exhibits, and get a snapshot of the hottest technology product sessions. ■

Event Date	Location
10/3/06	Houston
10/3/06	Cincinnati
10/3/06	Orlando
10/5/06	Rochester
10/5/06	Irvine
10/12/06	Santa Clara
10/24/06	Philadelphia
10/24/06	Milwaukee
10/26/06	Minneapolis
10/26/06	Pittsburgh
10/26/06	Dallas
11/2/06	Detroit
11/2/06	Salt Lake City
11/7/06	Boston
11/7/06	Huntsville
11/7/06	Phoenix
11/9/06	Raleigh
11/9/06	Chicago
11/14/06	Washington, DC
11/14/06	Albuquerque
11/14/06	Ottawa
11/16/06	Denver
11/16/06	Montreal
11/19/06	Mexico City
11/21/06	Toronto
11/28/06	Austin
12/5/06	Seattle
12/7/06	Portland

Table 1. Visit an NI Technical Symposium event near you.

National Instruments Worldwide Trade Show Calendar

Start	End	Show Name	Location	City	State or Country
8/18/06	8/19/06	ESC 2006	Taipei International Convention Center	Taipei	Taiwan
8/18/06	8/21/06	Taipei CarTronics 2006	Taipei World Trade Center Exhibition Hall	Taipei	Taiwan
9/7/06	9/9/06	Automotive Tradeshow	Shanghai Everbright Convention Center	Shanghai	China
9/12/06	9/14/06	Semicon	Taipei World Trade Center	Taipei	Taiwan
9/14/06	9/17/06	MICONEX	China International Exhibition Centre (CIEC)	Beijing	China
9/19/06	9/22/06	AutoTestCon	Disneyland Resort	Anaheim	California
9/26/06	9/28/06	13th China International Exhibition	Shaanxi International Exhibition Center	Xian	China
9/26/06	9/29/06	Assembly Technology Expo	Donald E. Stephens Convention Center	Rosemont	Illinois
9/26/06	9/29/06	Turbomachinery Symposium	George R. Brown Convention Center	Houston	Texas
9/27/06	9/28/06	WNCG Symposium	InterContinental Stephen F. Austin Hotel	Austin	Texas
10/6/06	10/9/06	Audio Engineering Society	Moscone Center	San Francisco	California
10/10/06	10/14/06	Taitronics	Taipei World Trade Center	Taipei	China
10/17/06	10/19/06	Convergence 2006	Cobo Hall	Detroit	Michigan
10/18/06	10/20/06	ISA Expo	Reliant Center	Houston	Texas
10/26/06	10/28/06	Automotive Testing Expo	Rock Financial Showplace	Detroit	Michigan
10/29/06	11/1/06	Frontiers in Education	Sheraton San Diego Hotel and Marina	San Diego	California
10/30/06	11/3/06	PACK Expo	McCormick Place	Chicago	Illinois
11/6/06	11/11/06	ASME International Congress and Exhibition	Chicago Hilton and Towers	Chicago	Illinois
11/15/06	11/17/06	Aerospace Testing Expo	Anaheim Convention Center	Anaheim	California
11/29/06	12/1/06	PowerGen International	Orange County Convention Center	Orlando	Florida
12/4/06	12/7/06	Inter-Noise	Waikiki Beach	Honolulu	Hawaii

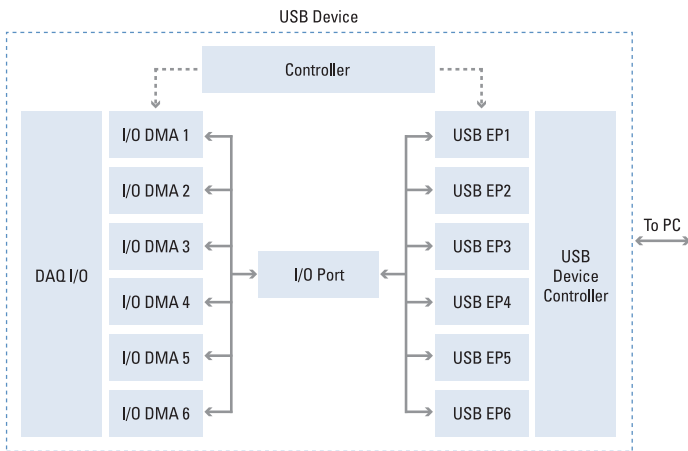
Table 2. National Instruments is exhibiting at a number of upcoming worldwide trade shows. Visit the NI booth to speak with an NI engineer and view a live product demonstration.

Gain Expertise from Webcasts

Join National Instruments for FREE 45-minute live Webcasts and Webcasts on Demand featuring the latest product and technology information, software demonstrations, and interactive question and answer sessions. With more than 200 topics available on demand, you are sure to gain the knowledge you need from expert presenters at the comfort of your own desk.

To view a list of the top 10 most popular Webcasts, visit ni.com/info and enter **nsi6335**.

NI Signal Streaming – High-Speed I/O over USB



Each data acquisition I/O DMA channel streams data directly to and from an endpoint on the USB interface to achieve high throughputs.

Introduced in 2001 as part of the USB 2.0 specification, Hi-Speed USB extended the USB bus rate by 40 times to 480 Mb/s. This increased throughput coupled with ease of use made USB an attractive bus for applications such as data acquisition. However, because Hi-Speed USB was originally designed for streaming data such as audio and video, using USB for bidirectional high-speed data streaming in data acquisition and control applications required some clever design work.

NI signal streaming technology, introduced in May 2006, solves this problem with a unique design that uses DMA-like bidirectional streaming over USB. This technology

from the host PC, thus virtually carrying the high-speed paths across the USB cable.

In addition to throughput improvements with bidirectional high-speed data streaming, NI signal streaming technology minimizes USB bus latency by moving part of the decision-making process down to the device. With this new capability, the data acquisition device can set up all necessary registers with a limited

number of transactions (data exchange) across the USB bus. This feature is especially important for single-point measurements in which several registers must be set up before every single sample is acquired or generated. National Instruments M Series data acquisition devices for USB are among the first USB devices to feature this technology. They offer a 400 percent increase in buffered analog input and up to a 1,600 percent increase in single-point acquisition rates. ■

Each endpoint independently streams data to or

optimizes data transfer within the device with data highways connecting the device I/O lines to the USB bus. These highways, implemented with DMA architecture, give each I/O function a direct path to an endpoint on the USB bus (see figure).

number of transactions (data exchange) across the USB bus. This feature is especially important for single-point measurements in which several registers must be set up before every single sample is acquired or generated. National Instruments M Series data acquisition devices for USB are among the first USB devices to feature this technology. They offer a 400 percent increase in buffered analog input and up to a 1,600 percent increase in single-point acquisition rates. ■

For a more in-depth look at NI signal streaming technology and related products, visit ni.com/info and enter [nsi6336](http://ni.com/info).



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Newsletter Information and Resources

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