

# Creating reliable and scalable motion control systems

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TO MEET THE VARYING NEEDS OF MOTION CONTROL ENGINEERS, NATIONAL INSTRUMENTS RECENTLY INTRODUCED THE CONCEPT OF MODULAR, ETHERNET-BASED MOTION CONTROL WITH PXI AND LABVIEW REAL-TIME.



*Computer-based distributed motion control with NI-Motion 6.0 and LabVIEW*

■ One of the significant trends in computer-based motion control right now is the increasing popularity of distributed control. Distributed motion control applications can range from remotely controlling an excavator that is digging up explosives to controlling various motion axes in an automated test machine. To help meet the varying needs of motion control engineers, National Instruments recently introduced the concept of modular, Ethernet-based motion control using any National Instruments PXI motion controller with NI-Motion 6.0 driver software in a LabVIEW Real-Time based PXI system. This type of method offers the ability to scale the system according to the needs of the machine. For example, if the machine requires high performance data acquisition for performing tests in the system, the engineer can simply use one of the available PXI slots in the chassis to add the extra data acquisition. Using this method, engineers have a wealth of I/O, high reliability, and the ability to remotely configure their system.

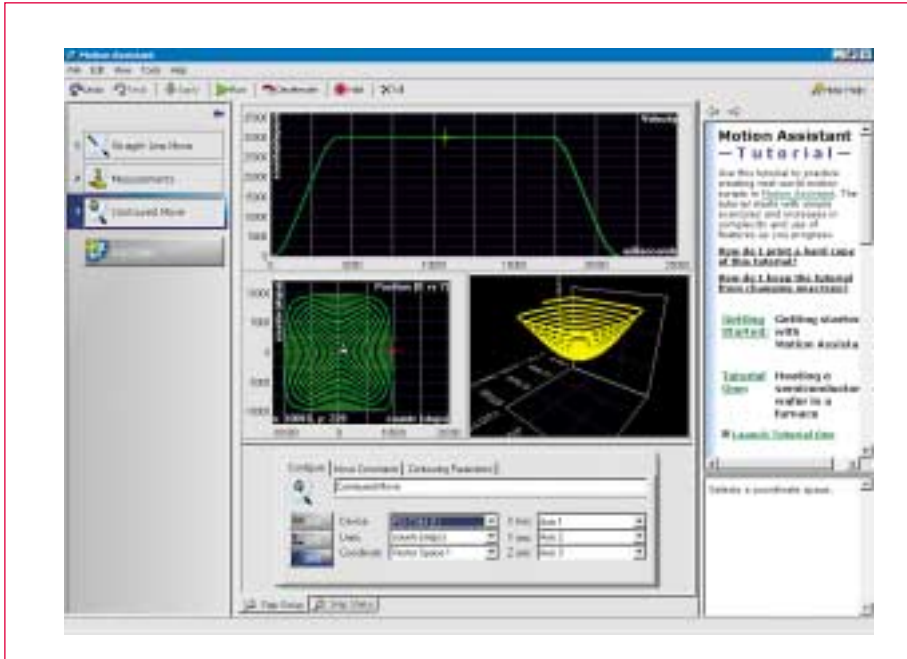
One of the first steps in creating any motion system is to configure and test it. With distributed systems, this portion can be difficult. National Instruments offers a free configuration and testing software called Measurement and Automation Explorer (MAX) with each controller to help make configuration of the system easier. Using the new remote configuration capability of

Measurement and Automation Explorer, engineers can easily configure remote systems the same way they would if the controllers were plugged directly into the host system. Engineers can also easily configure and integrate all of the other National Instruments hardware components in their system. This means that if there is data acquisition or image acquisition in the system, the engineer can easily configure these along with the motion using a single software package.

The NI solution is PC-based and uses LabVIEW, an easy-to-use graphical development tool. Using LabVIEW, engineers can easily create custom interfaces and communicate with a wide variety of motion control and I/O hardware in their machines. This makes creating an automated system easy and fast. Engineers can also easily prototype motion applications with NI Motion Assistant, a powerful prototyping tool for developing motion control applications. NI Motion Assistant helps engineers develop their application quickly by enabling them to simply create a sequence of motion profiles without programming. After creating this sequence, they can use Motion Assistant to visualize their motion control profiles before actually running them on the real system. After the motion profiles are complete, Motion Assistant can then automatically create LabVIEW code for performing those profiles. This type of approach makes the initial development

of motion profiles very easy, while at the same time providing the flexibility to integrate it into the rest of the system. Also, if the need arises to change the motion control hardware due to a change in the specifications of the system, the engineer can easily do this without having to modify the code making upgrades easy.

When machine builders and motion control engineers require reliability, what they often mean is that they need the machine or system to run as long as possible with minimal maintenance. Some machine builders are wary of computer-based motion control for their machines due to the general perception that PCs are not reliable enough to do critical tasks such as motion control. Real-time operating systems are a good alternative to the standard operating systems because they offer much higher levels of reliability and determinism. However, unless they are specifically trained on a special operating system and how to use it, most engineers prefer to develop their code using standard operating systems such as Windows that they are familiar with. To help bridge this gap and enable engineers to have both reliability and ease-of-use, National Instruments offers LabVIEW Real-Time, a technology that enables engineers to develop LabVIEW code in Windows and then download that code to a separate computer running a real-time operating system. For example, using National Instruments



*Motion Assistant — a development tool for building and prototyping motion applications*

LabVIEW Real-Time, you can develop your code on a standard Windows PC and then download it to a LabVIEW Real Time PXI controller. The LabVIEW Real-Time controller can then run standalone without the host PC and because it is running in a real-time operating system, it is highly reliable. This method helps to make high performance system development easier by enabling the engineer to use something familiar such as LabVIEW and Windows.

There are a variety of different bus options for distributed motion control. National Instruments uses Ethernet for distributed motion control solutions for a variety of reasons. Ethernet is one of the most common network busses in the world. It ships with nearly every computer

or can be easily added with an inexpensive network card. Ethernet can also extend for much longer distances than many of the other busses such as IEEE-1394 and is a very good solution for both machine builders and end-users.

One of the issues that many machine builders face today is that technology changes so fast that they often are not able to make machines that can keep up with the changes. Using scalable technology helps machine builders modify their machines as the technical requirements change. What is it that makes a motion control system scalable? Because it is a modular approach, the NI PXI Ethernet solution offers subsystems that the engineer can replace when new technology is available or when the system require-

ments change. For example, processor technology changes very rapidly and with those changes often come performance improvements. Taking advantage of those performance improvements helps make the machine faster or more efficient which could save money. This modular approach also gives engineers the ability to add in other components such as data acquisition or machine vision if the need arises.

Many machines that do motion control also do other types of I/O such as analog I/O, digital I/O, or even machine vision. For example, automated test machines often use motion control to move units from one test location to another. One of the complications with using distributed motion control is how to actually get the motion control to work in cooperation with this other I/O. Using the National Instruments modular PXI approach enables the engineer to use the PXI-based system to control I/O points, motion, data acquisition, and even supervisory system control. This also makes developing the code for the system easier because it can all be programmed and configured in the same development environment. This level of software integration helps engineers avoid the difficulty of having to develop and combine code in a variety of different languages or APIs.

National Instruments motion control hardware offers several features to help make integration more powerful as well. One of these features is high speed position triggering. With the new NI PXI-7358 motion controller, engineers can send out periodic position triggers to data acquisition or image acquisition boards at the rate of 4 MHz. These triggers can be sent to other boards through the back plane of the PXI bus giving engineers the ability to create highly integrated systems without having the burden of developing special cabling to communicate between the various components. ■