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A software designed future

As the PXI platform grows, much of its future development will be defined by software, argues **Jeremy Twaits**

Software always has been a pivotal aspect of modular instrumentation platforms. From the drivers that talk to the hardware, to the application software in which code modules are written, to the test executive that sequences that code, the importance of software is evident. And over the coming years, the impact of software will become even greater.

Sixteen years ago, National Instruments invented the PXI platform, which has software solidly at its core. Today, almost every commercial off-the-shelf (COTS) automated test system uses application software to communicate through a bus interface to the instrument. As applications become more complex, engineers are continuously challenged with the dilemma of increasing functionality without increasing test times and, ultimately, test cost.

To address the need for speed and flexibility, COTS test instruments have increased their usage of field-programmable gate arrays. While FPGAs in instrumentation represents a good first step forward, typically these FPGAs are closed with fixed personalities designed for specific purposes and allow little customisation. This is where user-programmable FPGAs have a significant advantage over closed, fixed-personality FPGAs. With user-programmable FPGAs, you can customise your instrument to the pin so that it is specifically targeted toward your application needs.

National Instruments has continued to innovate in modular instrumentation by bringing open FPGAs to the PXI platform, in creating the world's first vector signal transceiver VST). It is a new class of instrumentation that combines a vector signal generator (VSG) and vector signal analyser (VSA) with FPGA-based real-time signal processing and control. The VST features a user-programmable FPGA, which allows custom algorithms to be implemented directly into the hardware design of the instrument. This software-designed approach allows a VST to have the flexibility of a software-defined radio architecture with RF instrument class performance.

The VST is programmable with the NI LabVIEW FPGA Module, a graphical, dataflow-based system design environment that blends the processing done on an FPGA and a microprocessor in a way that does not require extensive knowledge of computing architectures and data manipulation. This is crucial in enabling users who are both experienced and inexperienced in traditional FPGA design to productively apply the power of reconfigurable hardware.

NI VST software features a multitude of starting points for your application including application IP, reference designs, examples and LabVIEW sample projects. Without these out-of-the-box capabilities, the productivity of LabVIEW and the well-crafted application/firmware architecture, the software-designed nature of the VST would be challenging for many users. With these traits, however, it brings unprecedented levels of customisability to high-end instrumentation.

There are many applications that can benefit from using FPGAs to perform computationally intensive tasks like custom triggering, FFT engines, noise correction, inline filtering, variable delays and data reduction. For example, on an FPGA, averaging can be performed faster, and hence more averages taken in the same time, leading to greater confidence in the measurement. Or in power amplifier characterisation, a proportional control loop can be implemented with low latency on the FPGA to allow faster settling at the desired output power. These applications are only the tip of the iceberg. Open FPGAs in test applications will find more and more uses, and the instrumentation of the future will be software-designed.

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