

Computers in engineering

Telescope microshutters tested using LabVIEW FPGA

With the help of **National Instruments'** (NI) LabVIEW field-programmable gate array (FPGA), the James Webb Space Telescope (JWST), **NASA's** successor to the Hubble Space Telescope, recently passed a milestone on its march toward a 2013 launch.

The JWST, a large IR telescope with a 6.5-m primary mirror, is equipped with more than 250,000 microshutters designed to observe thousands of distant galaxies in hopes of better understanding the origins of the universe. According to NASA, the JWST will study every phase in the history of our universe, ranging from the first luminous glows after the Big Bang, to the formation of solar systems capable of supporting life on planets such as Earth, to the evolution of our own solar system.

JWST represents an international collaboration between NASA, the **European Space Agency**, and the **Canadian Space Agency**. **NASA Goddard Space Flight Center** is managing the development effort, and **Northrop Grumman Space Technologies** is serving as prime contractor.

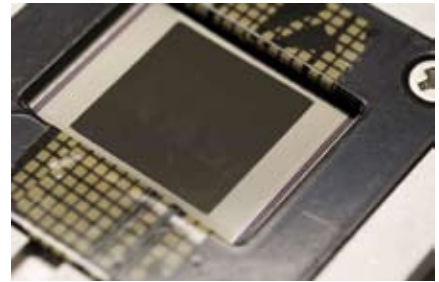
The microshutters, or more specifically microelectromechanical system (MEMS) devices, physically open and close for light exposure, enabling programmable object selection for the spectrograph. Engineers at NASA Goddard tested the microshutters using LabVIEW FPGA to control the shutters in a test chamber.

"LabVIEW FPGA and R Series intelligent DAQ [data acquisition] saved hundreds of man-hours and thousands of dollars," said David Rapchun, Lead Testing Engineer at **Global Science and Technology/NASA Goddard Space Flight Center**. "The decision to go with commercial off-the-shelf hardware instead of a custom solution provided a more cost-effective method, and the control algorithm can be easily modified to improve testing, explore shutter issues, and otherwise further the development of the microshutters."

NASA selected **Mink Hollow**

Systems, a National Instruments Alliance Partner, to develop the FPGA software required for a test application capable of actuating each of the nearly 62,000 microshutters tested at one time. The software was also required to provide design feedback and estimate the life of each unit.

Mink Hollow Systems employed the LabVIEW graphical development environment when developing the test software that would give engineers the ability to customize shutter actuation tests while monitoring and controlling the



The James Webb Space Telescope's near IR spectrograph is equipped with more than 250,000 microshutters to observe distant galaxies to better understand the origins of the universe. Engineers at NASA Goddard Space Flight Center tested the microshutters using LabVIEW FPGA.



The JWST, planned for launch in 2013, will be the premier observatory for the next decade, according to NASA.

test environment. LabVIEW FPGA was used to design a custom algorithm that could manage the synchronization required for opening and closing the shutters 240 times per minute.

"Using the FPGA on intelligent DAQ devices, we benefit from low-level synchronization as well as reliability," said Eric Lyness, Senior Integration Engineer at Mink Hollow Systems. "For example, if the shutter array were a picket fence with slats that were each 1 inch in width, the magnet would be moving past it at 600 mph. If our synchronization is off even for just a few seconds, the array could be damaged."

NASA engineers opened the shutters by sweeping a magnet, controlled with National Instruments PXI-7344 motion controllers, across the array of shutters. Individual shutters within each array were controlled through National Instruments' PXI-7811R and PXI-7813R intelligent DAQ modules. Using mag-

nets to open and close the shutters reduced the impact of a shutter on a light baffle, significantly extending the life of the shutters.

NI motion controllers were used to regulate the position of a camera that acquired images during testing, and other NI hardware was used to collect data from temperature sensors and vacuum readouts. Engineers compared test results and made adjustments if necessary.

The test system developed by Mink Hollow Systems is capable of testing the reliability of the microshutters for up to 100,000 cycles and for various shutter designs. The system expedites the testing process by cycling the shutters open and closed up to four times per second. During the 10-year lifetime of the telescope, the microshutters may be required to open and close more than 60,000 times.

Matt Monaghan

Computers in engineering

Mercury, PNNL leverage gaming technology for use in UAVs

The defense and security fields may soon benefit from some of the computing power used in next-generation gaming consoles. **Mercury Computer Systems** and **Pacific Northwest National Laboratory** (PNNL) have teamed to apply multicore technology such as graphics processing units and the cell broadband engine processor, currently used in gaming devices such as the **Sony PlayStation3**, to these areas.



George Michaels, Associate Laboratory Director of the Computational and Information Sciences Directorate at Pacific Northwest National Laboratory, said the relationship with Mercury Computer Systems will increase the efficiency of existing computer software applications as well as develop new areas of application for emerging processor technologies.

As a result of their collaboration, the firms have indicated that streaming data can be analyzed in real time, which has been a critical challenge for data-intensive computing. The new computing power could be used on UAVs to partially analyze incoming data on-board. Multicore processing could also improve the efficiency of cyber security for large computer networks.

Mercury and PNNL will combine their expertise in a new Computational



The VistaNav-SSR (smart surveillance and reconnaissance) is a complete, high-performance unmanned aircraft system that includes a ground control station integrated with 3-D synthetic vision and a small UAV. UAV technology is one of the areas expected to benefit from the multicore technology used in next-gen gaming devices.

Center of Excellence, with contributions from each including hardware, software tools and middleware, newly developed algorithms, and dedicated personnel.

"We're excited to be working with PNNL, and about the possibilities of applying multicore computing technology to enable the development of economically viable computing solutions to previously intractable problems," said Jay Bertelli, President and CEO of Mercury Computer Systems. "Early results from our collaboration show that, together, we can analyze streaming data in real time, which has been a critical challenge for data-intensive computing. Our goal is to open the door for new applications."

Equipment on UAVs needs to be minimal in size, weight, and power. Multicore processors are a good fit for these applications because they consume relatively low amounts of power while processing complex and large amounts of information. With the proper software, Mercury said the processors could potentially provide the ideal fit for computationally intensive applications.

"PNNL has a rich history of solving computational challenges within government and industry. This relationship with Mercury helps us take a giant leap forward in our ability to positively impact our customers' missions," said George Michaels, Associate Laboratory Director for PNNL's Computational and Information Sciences Directorate. "The marriage of our software development expertise with Mercury's capabilities allows our experts to increase the effi-

ciency of existing computer software applications. More importantly, it allows us to develop new areas of application for emerging processor technologies."

Mercury has experience in the UAV arena with its VistaNav-SSR (smart surveillance and reconnaissance) unmanned aircraft system (UAS). The VistaNav-SSR system features miniaturized airborne and mission computing image-processing capabilities designed to improve control and command functions, increase situational awareness, and integrate ground-imaging computations for aerial remote sensing applications. The Remote Sensing Applications Center of the **U.S. Department of Agriculture** Forest Service recently selected Mercury to support wildlife monitoring and forest mapping projects this year.

Multicore processing could also improve the security of large computer networks. Rather than having a system that collects millions of pieces of information and then sends it to a central location for processing, the analysis could be done at a sensor that acquires or monitors the data.

Previously, the processing speed needed to analyze the large amount of security data generated by today's technology has not been available in a cost-effective suite of hardware. With more power in a compact form, a laptop-size supercomputer could become a reality for surveillance in multiple locations enabled by portable, real-time processing.

Matt Monaghan