INCORPORATION OF A PBSE ARRAY BASED SPECTROGRAPH INTO EPICS USING LABVIEW AT THE JLAB FEL FACILITY

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Abstract

A real-time spectrograph with a 1Hz update rate was designed and installed at the JLab FEL facility using a Cal Sensors PbSe array and a Roper Scientific SpectraPro 300i monochromator. This device is automated with the use of new control controls software. This paper describes the components of the software for the real-time spectrograph and its performance. The software consists of an EPICS channel access client (CA) on a remote PC running LabVIEW with modified vendor software. This allows PC based diagnostics to be used in EPICS.

INTRODUCTION

LabVIEW drivers are available for several PC based devices used for optics measurements at the FEL facility. The software controls of the FEL accelerator and optical components are implemented in the Experimental Physics Industrial Controls system (EPICS). It was desirable to have a few of the parameters in the LabVIEW applications available to the operators during FEL operations using remote workstations in the EPICS environment through EPICS channel access (CA). It was not necessary to include all of the LabVIEW controls for remote operation over the LAN in EPICS. A quick and simple solution was to use the LabVIEW channel access interface developed at LANL [1] with “generic” EPICS records, and to add only the controls needed by the operator. In this way much time and money was saved by the use of PC based hardware, and simple modification of vendor supplied LabVIEW VI’s. This paper describes the addition of channel access client to the PC, and modification of the vendor LabVIEW VI’s to perform channel access.

EPICS ON A PC

The LabVIEW application was controlled through a remote display screen with EPICS CA. Communication via EPICS was through records located on a remote server that were reserved for this purpose. With CA polling the LabVIEW program observed requested operator commands from the EPICS display manager (DM). Appropriate display information from the LabVIEW program was then routed back to the DM screen via CA. Because both the LabVIEW program and the operator DM screen are clients, installation of EPICS base was not required for this application. Ten records representing all record types were maintained on a standard JLAB MV2700 input/output controller (IOC) running EPICS CA server with the VxWorks operating system. Extra records were added for future programs. A record use screen was added to keep track of which applications were using each record.

Configuring a PC as an EPICS client [2] consisted of installing the application executables in a directory with appropriate operating system paths. A script was also run that registered the CA routines and an ActiveX interface with the operating system. An environment variable containing The IP addresses of the IOCs and CA servers was added for the CA routines.

SPECTROGRAPH HARDWARE

The spectrograph hardware consisted of a Roper Scientific SPI -300i monochromator/spectrograph, a CalSenors PbSe 256 element array, and a mini-itx PC. The SpectrPro -300i was set up in spectrograph mode with the desired center wavelength from the exit of the SPI 300 selectable through standard GPIB EPICS controls. The output of the SPI 300i was centered on the PbSe array as shown in Figure 1.

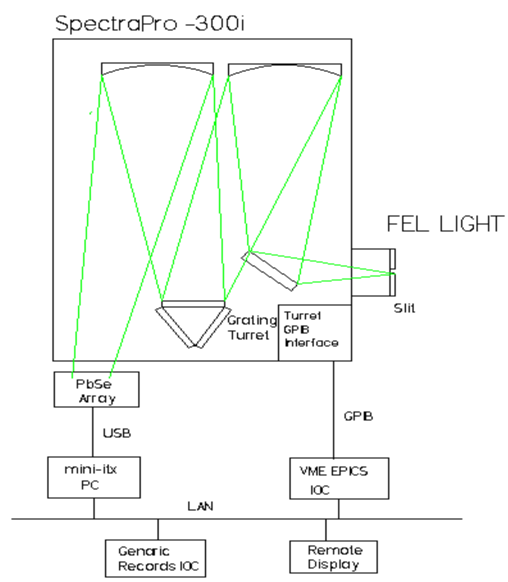

Figure 1: Spectrograph Hardware.

The LabVIEW software interfaces the PbSe array through USB port on a PC. The mini-itx computer was chosen for space considerations in a small optical control room.

LABVIEW PROGRAM

The LabVIEW code shown in Figure 2 was added to the VIs supplied by Cal Sensors. The program loop was run concurrently with the PbSe array data gathering loop.

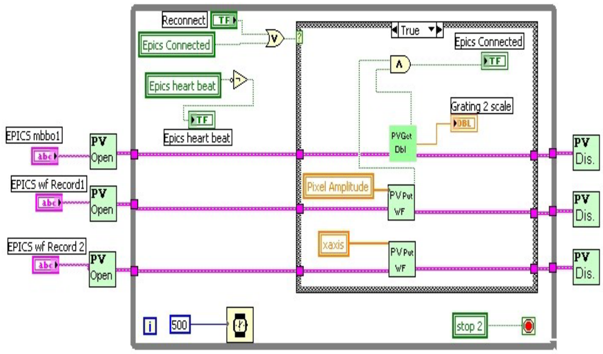

Figure 2: PV Loop.

The local variable "Pixel Amplitude" contained the array data sent to the remote DM display and was updated by the CalSensors VI every 300 ms. Before a PvPut or PVGet was performed a check was made to verify the last CA attempt was successful. This was to prevent a build up of pending CA events in case the network is not available. The PvGet was used to monitor an mbbo EPICS record from the operator DM screen. This was used to monitor the grating being used on the SpectraPro 300i for proper scaling of array data to the operator display. In this application 2 of the 3 available gratings were used.

The proper span and resolution was needed for each grating. SCALE GET and RANGE VIs were written to generate a 256 element array for the x-axis with proper scaling.

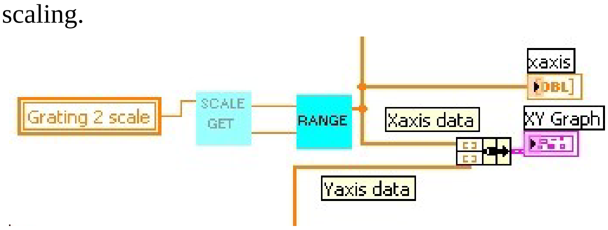

Figure 3: Array Data Scaling.

This program was added to the CalSensors main program loop. The Y axis data was wired directly from the CalSensors VI data line. This spectral array amplitude data was sent to both a local display for the PC, and an array which was sent via CA to the operator interface for remote display of the spectra. The X axis variable in Figure 3 was the same local variable sent over the network via CA.

OPERATOR CONTROLS

The remote DM operator screen as shown in figure 4 was used to display the FEL light spectra. The X any Y axes for the display were provided by two EPICS waveform records. The two gratings for the SPI 300i used were 150 g/mm, and 600 g/mm. The useful spectral response of the PbSe array was from about 1.6 to 5.0 microns. The spectrograph was set up to measure wavelengths from 1.5 to 3.7 microns. There were two ways to set up the spectrograph for measurements. In the first there were several pre-selected center wavelengths were available for each of the two gratings. These were available on menu buttons. To perform a measurement the desired grating was selected, the center wavelength was selected for that grating, and the center wave length was then sent to the spectrometer. Another method was to enable the center on position button and enter the desired wavelength into the position desired box.

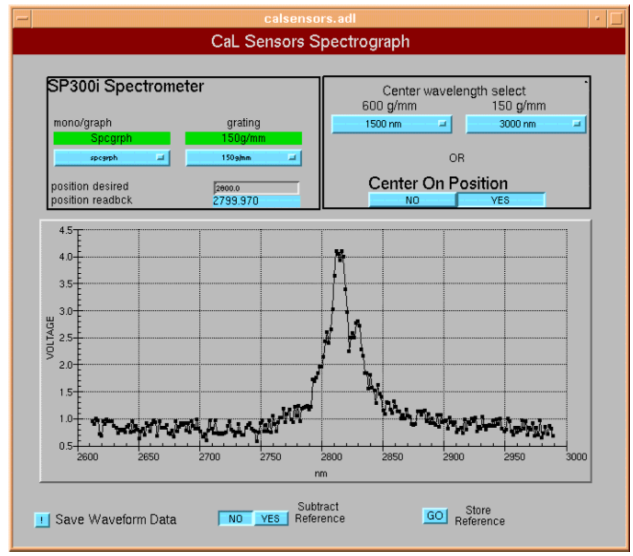

Figure 4: Operator Controls.

CONCLUSIONS

When a small number of EPICS records in an existing LabVIEW application are needed to be accessed by operators, then this "client to client via server" method of channel access is a quick, simple, effective, and inexpensive method to use. Complete installation of EPICS base software is not necessary. Drawbacks of this method are it is not scaleable, and is no longer supported by the EPICS community. LabVIEW CA via ActiveX is not available beyond EPICS release R3.13 Further LabVIEW EPICS support exists with the shared memory library implementation [3]. Other applications that use of this method that are in development include interface of an Ocean Optics HR2000 spectrometer, and a THz power meter. Further enhancements of this application are implementation of a larger spectral range, and automation of the measurement process.

ACKNOWLEDGMENTS

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