NEW CONTROL SOFTWARE FOR CEBAF WIRE SCANNERS*

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Abstract

Wire scanners (WS) are the most popular beam profile measurement devices at Jefferson Lab. The WS for the CEBAF accelerator and beam extraction lines were created and supported by different user groups. As a result, they are not only implemented in different hardware standards (CAMAC and VME) but until recently also had different control functions that made them very difficult to use for accelerator beam diagnostic applications. To integrate all WS into one homogeneous system that is very easy to support and use for accelerator operations, new WS control software has been created. The software is implemented as a library of WS control and status modules. The control modules handle the WS hardware components and make their data available for beam diagnostic applications. The status modules monitor data communication channels between WS components and control computers and generate alarms in case of hardware failures. The paper presents the functionality of the new WS control software and its positive impact on accelerator operations.

INTRODUCTION

WS are very important devices to measure beam profiles. The basic idea of WS is simple. A stepper motor moves a set of thin (tungsten, carbon, etc.) wires through the beam. The amount of the beam particles intercepting a wire changes depending on the shape of the beam. A typical WS consists of at least two wires to measure vertical and horizontal beam profiles. The beam profile is completely defined by the level of the signal generated by the interaction of the beam with a wire as the function of the position of the wire. The signal can be either an induced voltage on the wire or the amount of scattered electrons registered by Cherenkov detectors. A simplest WS hardware configuration consists of a stepper motor with its controller and a set of synchronized ADC boards giving the positions of the wires and beam profile related signals.

WS for the CEBAF accelerator and beam extraction lines were created and supported by different user groups at Jefferson Lab. As a result, they are not only implemented in different hardware standards (CAMAC and VME) but until recently also had different control functions that made them very difficult to use for accelerator beam diagnostic applications. In the conditions of very strong requirements to the availability of WS for accelerator operations, the support of all WS systems was gradually delegated to the controls software group. This made it possible for the controls software group to develop new WS control software that integrates all WS into one homogeneous system, which is very easy to use for accelerator operations. The work on the new WS controls was done in parallel with significant modifications of the CAMAC support software.

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CAMAC SUPPORT SOFTWARE MODIFICATIONS

The core part of the CAMAC driver and device support software (CEBAF CAMAC Library) was created at Jefferson Lab about ten years ago [1]. It provides the communication between the control computer (IOC) and the CAMAC hardware via a HYTEC VSD 2992 Serial Highway Driver VME card. The CAMAC Library is one of the very important extensions to the EPICS toolkit and is supported by Jefferson Lab for the whole EPICS community. In the last two years a great effort was made towards the detailed diagnostics of the CAMAC data highway and Serial Highway Driver cards. A new version of the CAMAC library was created to register all possible failures on the way of data from the control hardware to the EPICS distributed database and make them immediately available for the accelerator control system in the form of alarms, which are managed by the EPICS Alarm Handler. The new library also has an advanced remote CAMAC status monitoring tool based on the RPC protocol. The troubleshooting of any CAMAC related problems in the control system now only takes a few minutes for any electronics technician that significantly contributes to the high availability of the CEBAF accelerator for the nuclear physics experiments.

NEW WS CONTROL SOFTWARE AND ITS STRUCTURE

New WS control software consists of WS control and status libraries.

The WS control library is made up of the following software elements (see Fig. 1): stepper motor, wire scanner configuration, and wire position and signal control modules. Let us describe these elements in more detail.

- The stepper motor control module handles WS motion sequences. This software module supports VME based OMS and CAMAC based M540 motor controllers, which are used in all CEBAF wire scanner systems. The basic WS mode provided by the stepper motor control module is a forward run with a specified speed until the installed limit switch latches and then the immediate run back to the original or home position. Another WS mode supported by software is a continuous motion between two specified motor positions and the run to the home position on user's request. These two modes cover all required WS operations at Jefferson Lab.

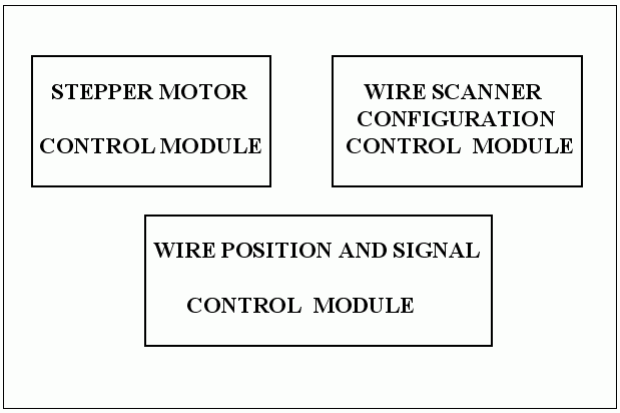

Figure 1: WS control software library components.

- The wire position and signal control module handles the data acquisition cards that collect and provide the information about the stepper motor positions and corresponding wire signals. The software supports a variety of CAMAC or VME based ADC and waveform digitizer cards such as AURORA Transient Recorder and BiRa 5333 ADC boards. The information about beam profiles can be either read directly from ADC cards in real time or first collected by waveform digitizers and then read from their memory buffers. As a part of the distributed EPICS database, the beam profiles become immediately available to all accelerator control applications.

- The wire scanner configuration control module provides all required accelerator WS modes together with some very specific beam energy measurement (ARC) modes, which are still requested by accelerator users. The accelerator and ARC modes have different control functions. For example, in ARC modes all WS control parameters are fixed and defined in configuration files. In contrast, as part of the EPICS database all WS control parameters in accelerator modes are dynamic. The new wire scanner configuration control module allows users to easily switch between these two modes by setting the WS mode flag (that is an EPICS binary output record) into 0 (accelerator) or 1 (ARC).

The diagnostics of all possible WS failures is provided by the WS status software library. The library consists of the IOC, VME, and CAMAC status modules.

- The IOC status module monitors the state of the control computer running the WS control software and generates alarms in case of the IOC memory, operating system, and hardware configuration problems.

- The state of the all VME cards used by WS (including HYTEC Serial Highway Driver boards) is monitored by the VME status software module. If any of these cards fail, software immediately generates alarms associated with the failures.

- The CAMAC status module is based on the new CAMAC library and provides the detailed diagnostics of all CAMAC cards used by WS.

CONCLUSION

New WS control software has been in successful operations at Jefferson Lab for more than one year. The software is extremely easy to use for various beam diagnostic applications [2]. The software also provides the detailed diagnostics of any possible WS hardware problems generating alarm signals and providing troubleshooting guides associated with these alarms. The possibility to run ARC WS in accelerator modes has significantly increased the efficiency of existing wire scanners for all required beam diagnostic procedures.

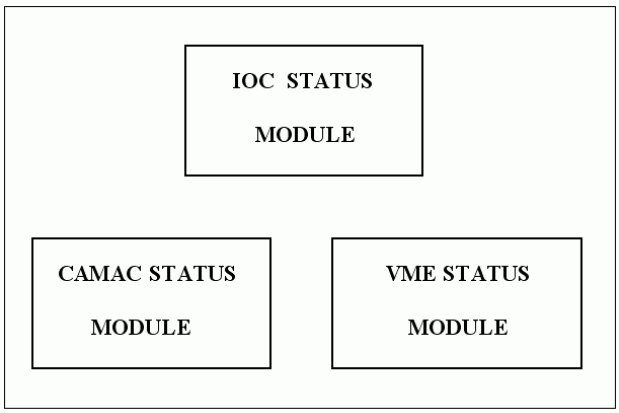

Figure 2: Elements of the WS control software library.

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[2] Y.-C. Chao, P. Chevtsov et al. “Energy Spread Monitoring for the JLAB Experimental Program: Synchrotron Light Interferometers, Optical Transition Radiation Monitors and Wire Scanners”, Beam Instrumentation Workshop, Knoxville, TN, 2004.