DEVELOPING OF PBPM DATA ACQUISITION CONTROL SYSTEM FOR THE PLS

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Abstract

The prototypes of PBPM of the four blade types were installed in front-ends 1C1 diagnostic beam line. The four-blade PBPM measure both the horizontal and the vertical positions of the photon beam. KeithleyTM picoammeters are used to record the blade current. The position in both vertical and horizontal directions is calibrated by driving the stepping motors of the PBPM through an Industrial computer. PBPM Data Acquit ion Control System (DACS) is based on Window XP platform. The DACS is equipped with an Ethernet-to-GPIB controller (GPIB-ENET/00). Using the GPIB-ENET/100, networked computers can communicate with and control IEEE 488 devices from anywhere on an Ethernet-based TCP/IP network. This is GPIB interfaces four picoammeters and Ethernet-based TCP/IP communicates by Industrial Computer. Developing with LabVIEW for Windows XP, the interface to EPICS is accomplished by means of Win32 channel Access DLL's. Our LabVIEW application program incorporates EPICS-based motor control and PC-based data acquisition, using a National Instruments I/O board, and saves position data to txt files. This paper presents the PBPM DACS for PLS Control System.

INTRODUCTION

The accurate determination of the photon beam position is important in every beamline. Since the distance from the photon source to the experimental station is relatively long (typically 15~20 m), a small angular beam deviation at the source can produce a large movement at the experimental location. This problem is critical in the case of undulators where the usable dimension may be only a few millimeters. In addition, the signal from the beam position monitor can be used as a feedback signal to ring trim magnets. These in turn will alter the path of the electron beam in the insertion device to correct the photon beam error.

For the PLS, we installed photon beam position monitors (PBPMs) in the frontend of beamlines. Figure 1 shows schematic diagram of installed 1C1 PBPM. Since the frontend is a starting point of the beamline, the PBPM can provide information of the beam position stability from the viewpoint of the beamline user. In addition, we will use not only the BPM data but also the PBPM data for the global and closed orbit feedback. In that case, beamline users may enjoy 5μm beam-position stability which is already achieved in the PLS by using the BPM-based orbit-feedback system. For this purpose, PBPM should meet fallowing conditions: (1) it causes little intensity perturbation downstream of its position, (2) it is non-destructive to the synchrotron radiation, (3) it is suitable for continuous use, and (4) it must withstand high thermal loads and achieve submicron level spatial resolution while maintaining stability [1].

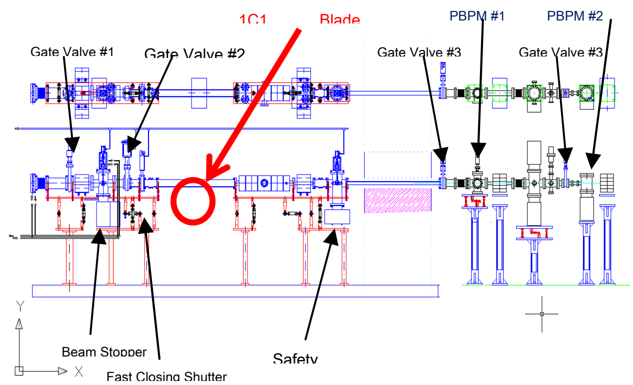

Figure 1: Schematic diagram of 1C1 PBPM.

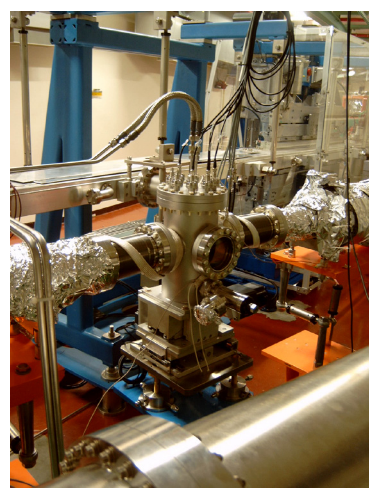

Figure 2: Photo of 1C1 PBPM.

The prototypes of PBPMs of the four blade types were installed in front ends 1C1, resistively .The two-blade PBPM measures only the vertical position of the photons beam. The four-blade PBPMs measure both the horizontal and the vertical positions of the photon beam. Additionally, a new version of the PBPM for bending magnet sources will has been installed in front ends 3A, 5B and ID. Figure 2 shows a picture of the PBPM assembly for the BM source. KeithleyTM picoammeters are used to record the blade current. The position in both vertical and horizontal directions is calibrated by driving the stepping motors of the PBPM through a personal computer (PC). Figure 3 shows monitor of PBPM vertical position data

Figure4 illustrates the calibration of a 4-blade PBPM in vertical direction. The current of each blade during the movement of PBPM in vertical, y, direction is plotted in Fig. 4. The calibration factor, Ky, is obtained from the slope of the linear fitting of the curve in Fig.4. The positions of the PBPM in both y and x direction are calculated according to the following equations,

Y (_ m) = Ky [_ (IU) -_ (ID)] / [_ (IU) +_ (ID)] (1)

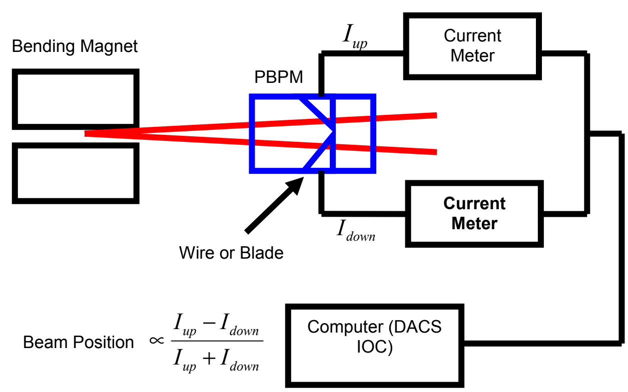

Figure 3: Schematic diagram of 1C1 PBPM monitor data.

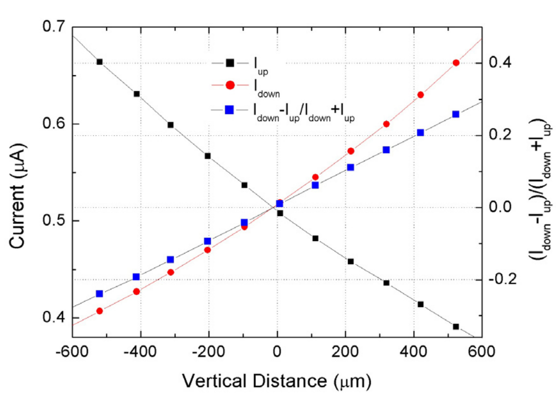

Figure 4: The calibration factor.

SYSTEM CONFIGURATION

To monitor the nine PBPM distributed into beam-line, we installed PBPM DACS IOC each beam-line. Various PBPM detectors and DACS hardware's are summarized in the Table 1.

Table 1: Current Status of Installed Various PBPM.

BL	Detector	Position	DACS
1C1	Blade	FE & PTL	KE6485 & GPIB_Enet Industrial PC (IOC)
3C2	Blade	PTL	KE6485 & PC (IOC)
4B1	Blade	FE	KE6485 & PC (IOC)
4C1	Wire	FE	KE6485 & GPIB_Enet
5A	Wire	FE	Current Meter & PC (IOC)
6B	Blade	FE	KE6485 & GPIB_USB
6C	Blade	FE&PTL	KE6485 & GPIB_Enet
8A1	Blade	PTL	KE6485 ,PC(IOC)
8C1	Blade	FE	KE6485 &PC (IOC)

PBPM Data Acquit ion Control System (DACS) is based on Window XP platform. The DACS is equipped with an Ethernet-to-GPIB controller (GPIB-ENET/100). Using the GPIB-ENET/100, networked computers can communicate with and control IEEE 488 devices from anywhere on an Ethernet-based TCP/IP network. This is GPIB interfaces four picoammeters and Ethernet-based TCP/IP communicates by Industrial Computer. Developing with LabVIEW for Windows XP, the interface to EPICS is accomplished by means of Win32 channel Access DLL's. Our LabVIEW application program incorporates EPICS-based motor control and PC-based data acquisition, using a National Instruments I/O board, and saves position data to txt files. Figure 5 shows structure of current PBPM DACS

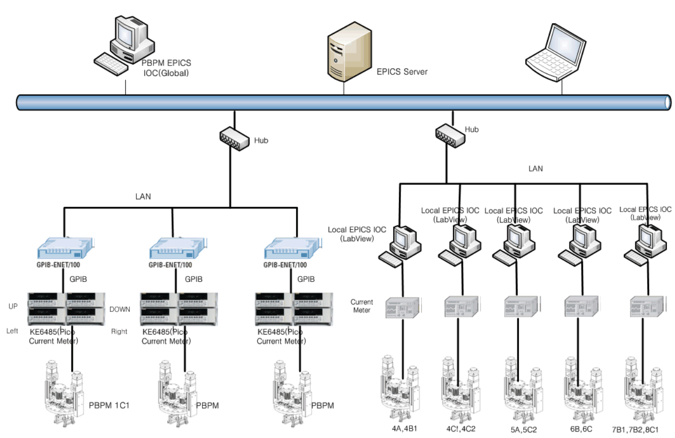

Figure 5: Structures of PBPM DACS.

It may represent a less expensive alternative platform for controlling a complex experimental set-up increasing also the system performances. The development of a new generation of diagnostic detectors at PLS allows investigating this opportunity. All PC DACS IOC is difficult to maintenance and analyze the required data as it has a long period of scanning. BPM Embedded IOC is developed for PBPM monitor to improve the problem, to see current PBPM position by EPICS Web server from anywhere in PLS through network. Its hardware configuration is HP Ethernet to GPIB Gateway E2050. Embedded EPICS IOC for target instrument control and monitoring. GPIB interface with instruments Ethernet 10/100 Mbps. RS232 serial port is 9600 bps for debugging. Figure 6 show configuration of PBPM Embedded EPICS IOC.

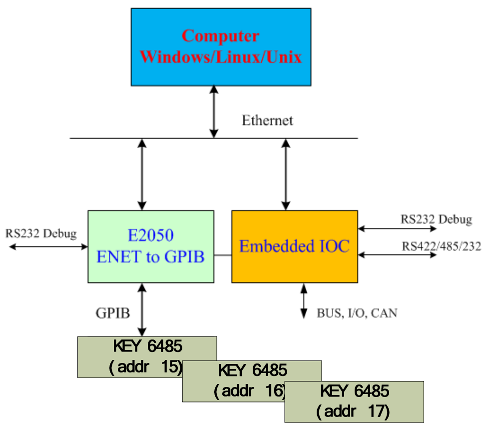

Figure 6: Configuration of PBPM Embedded EPICS IOC.

SOFTWARE

The new graph user interface software was designed based on one year of experience with a test running system. The host computer also serves a development environment for Linux, which is the operating system of IOCs. LabVIEW communicates with the EPICS IOC using a simple shared memory interface implemented in a dynamic linked library (DLL) based on previous work by Los Alamos National Laboratory. The DLL supports events and buffered communication of scalar data types such as integers, floats, and booleans, as well as single dimension arrays and strings. The LabVIEW programmer needs only minimal EPICS knowledge to use the interface. The PCs currently run Windows as their operating system and LabVIEW as their programming environment. The Shared Memory Interface (SMI) has three components: a dynamic link library (DLL), modified IOC device support, and a LabVIEW library [3].

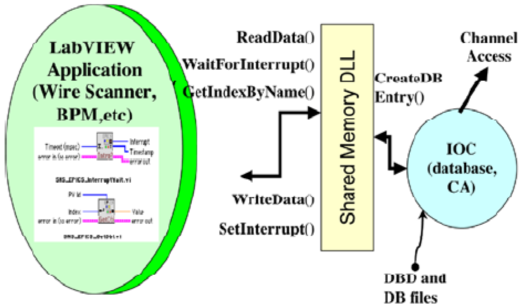

Figure 7: The Shared Memory Interface [2].

SYSTEM UPGRADE

The PBPM systems of the PLS are based on rack-mounted PCs with off-the-shelf and custom PCI hardware and LabVIEW. About nine systems are already installed and have been integrated into the EPICS-based control system. Some control requirements of the PBPM current meter is changed to embedded current meter and communication modify MODBUS/TCP protocol. The structure of the upgrade PLS-II PBPM control system is shown in Fig. 8. The control system is cPCI (CRIO) based system and Embedded EPICS IOC.

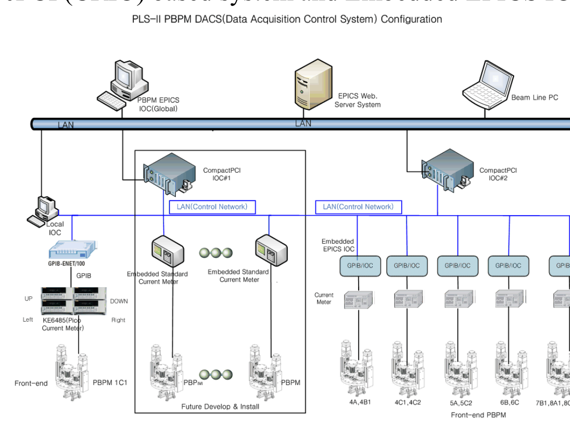

Figure 8: Structure of PLS-II PBPM Control System.

CONCLUSION

The PLS-II is an upgrade project of the existing PLS linac and storage ring. The main purpose of this project is an improvement of the electron beam quality to provide the better synchrotron radiation to beamline users.

We are upgrading and modifying the DACS EPICS[3] control system to accommodate new control requirements and to apply long-term test experiences. Owing to the upgrade project of current meter embedded controller, we have the chance to carefully examine and rebuild our intelligent embedded RTEMS for current meter embedded IOC subsystem. We have upgraded PBPM DACS Hardware by cRIO System. The upgrade PBPM DACS IOC will be installed in EPICS IOC based and system control test in 2010.

REFERENCES

[1] "Conceptual Design Report of PLS-II", Arial 2009
[2] D. Thompson and W. Blokland, "A shared Memory Interface between Labview and EPIC", ICALEPS2004, Gyeongju, Korea, March 2004
[3] http://www.aps.anl.gov/epics/