INTRODUCTION OF BEAM POSITION MONITOR SYSTEM IN THE HLS II STORAGE RING*

F. F. Wu, Y. L. Yang #, B.G. Sun, K. Xuan, H. X. Lin, P. Lu, Z.R. Zhou, L.L. Tang, J. G. Wang, T. Y. Zhou, X.Y. Liu, J. H. Wei
National Synchrotron Radiation Laboratory
University of Science and Technology of China, Hefei, 230029, Country

Abstract

Beam position monitor(BPM) system for the HLS II storage ring were designed in the HLS II upgrade project. This system is composed of BPM, BPM processor embedded with IOC and OPI. Every component of BPM system is introduced in this paper. BPM processors have different modes of data, such as ADC data, turn-by-turn(TBT) data, fast acquirement(FA) data and slow acquirement(SA) data. Different modes of data are used to different applications. Two applications based on SA data of the BPM system, such as BBA for quadrupole magnet center measurement and beam closed orbit feedback, are described in detail. The result of BBA shows that most magnetic centers of quadrupole magnets are in the range of [-1 mm, 1 mm] with respect to BPM electric centers. The result of beam closed orbit feedback shows that beam orbit stability when the closed orbit feedback system is on is far better than that when the closed orbit feedback system is off.

INTRODUCTION

Hefei Light Source II (HLS II) is a second generation Light Source. Beam energy is 800 MeV and natural beam emittance is about 40 nm·rad. HLS II has been upgraded from August 2010 and now enter normal operational phase. BPM system is one of the most important beam measurement systems. It plays an important role in commissioning and normal operation stages. In this paper, structure and all compositions for the BPM system of the HLS II storage ring are introduced in detail, additionally, related application based on the BPM system are descripted.

BPM SYSTEM OF THE HLS II STORAGE RING

BPM system structure for the HLS II storage ring is shown in Fig. 1. This system is composed of BPM, BPM processor embedded with IOC and OPI. Electrode induced signals of BPM are transmitted through the LMR-400 low-loss coaxial cable and cable adapter with SMA connector and the transmitted signals are inputed into BPM processors for sampling and digitizing. IOC embedded in BPM processor is used for platform management and algorithms application. IOC supports EPICS protocol, so data of different modes can be obtained through the EPICS protocol. The role of OPI is to control and monitor some IOC parameters.

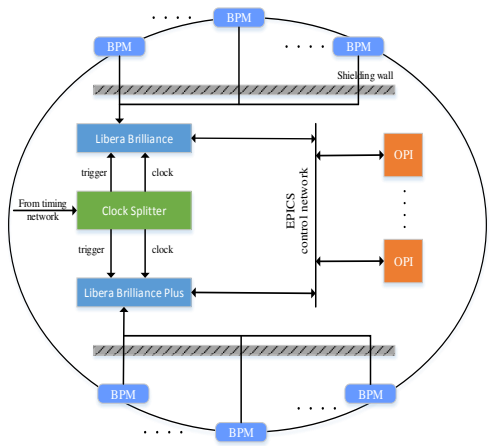
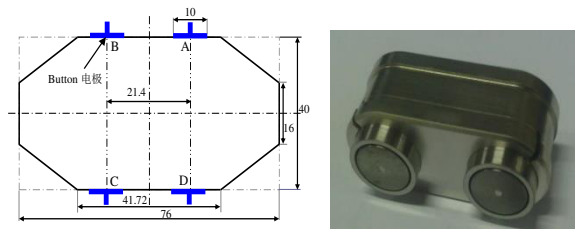


Figure 1: BPM system structure for the HLS II electron storage ring.



(a) Schematic diagram (b) Electrode assembly

Figure 2: Button BPM of the HLS II storage ring.

BPM

BPM used for the HLS II storage ring is Button BPM[1]. Schematic diagram of the Button BPM is shown in Fig. 2(a). The unit of sizes in the Fig. 2(a) is mm. All Button BPMs of the HLS II storage ring are machined by Kyocera company. Electrode assembly of the Button BPM is shown in Fig. 2(b) and electrode assembly was directly welded in the vacuum chamber.

BPM Processor

BPM processors used for BPM system of the HLS II storage ring are Libera Brilliance and Libera Brillianceplus which is updatad product of Libera Brilliance. They are produced by Instrumentation Technologies Company[2]. Compared to Libera Brilliance, Libera Brillianceplus has four BPM modules and more advanced optimization algorithms. Physical map of Libera Brillianceplus is shown in Fig. 3.

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ylyang@ustc.edu.cn

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Figure 3: Physical map of Libera Brillianceplus.

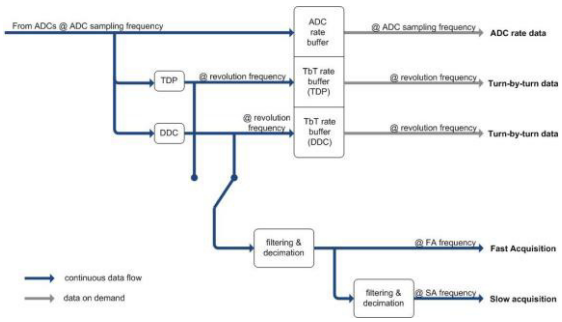

Figure 4: Signal processing flow chart of Libera Brillianceplus.

Through filtering, sampling, digital down converter, and decimation for input signals, data of different modes can be obtained. Signal processing flow chart for Libera Brillianceplus is shown in Fig. 4. These data of different modes include ADC raw data, turn-by-turn data, fast acquisition(FA) data and slow acquisition(SA) data. Data of different modes can be used to different applications. Some applications will be illustrated later in this article.

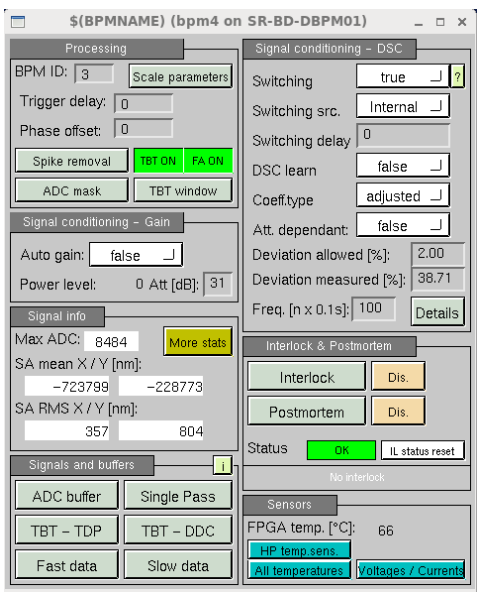

Figure 5: OPI for one module of the Libera Brillianceplus.

OPI

OPI is to control and monitor some IOC parameters for BPM processors. The OPI for the BPM system of the HLS II storage ring is coded with edm software. Values of most PVs can be monitored and set through the OPI. The OPI for one module of the Libera Brillianceplus is shown in Fig. 5.

APPLICATION BASED ON BPM SYSTEM OF THE HLS II STORAGE RING

BBA

In order to ensure stability of beam movement and provide users with a constant light source point position, beam closed orbit measurement in the electron storage ring is very important. Beam closed orbit passes through magnetic centers of the all 32 quadrupole magnets. BBA(Beam Based Alignment) is used to measure magnetic centers of the all 32 quadrupole magnets in the HLS II storage ring. The principle of BBA is introduced in [3, 4].

Through BBA, magnetic centers of the all 32 quadrupole magnets were obtained. Magnetic center of RNG:QPU:QUAD:QD1 measured with BBA is shown in Fig. 6. Statistical results of all magnetic centers of 32 quadrupole magnets show that most magnetic centers are in the range of [-1 mm, 1 mm] with respect to BPM electric centers.

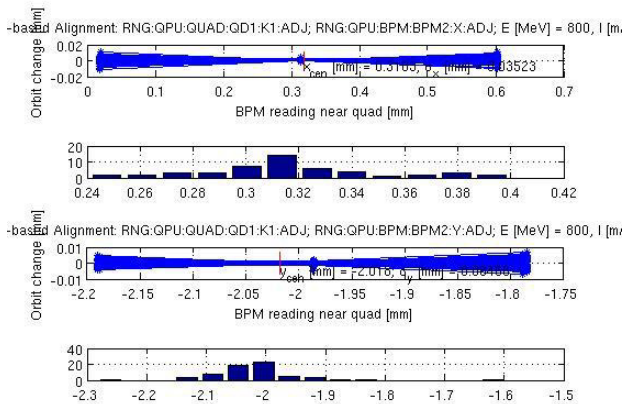

Figure 6: Magnetic center of RNG:QPU:QUAD:QD1 measured with BBA.

Beam Closed Orbit Feedback

Closed orbit feedback is an effective way to obtain high beam orbit stability which can meet the needs of user experiments. The system diagram of the Closed orbit feedback system in the HLS II storage ring is shown in Fig. 7[3].

The closed orbit feedback system in the HLS II storage ring is composed of beam closed orbit measurement system, closed orbit feedback control system and orbit correction system. All BPMs and corrector magnets are involved for the closed orbit feedback system. Horizontal and vertical beam positions measured based on all 32 BPMs when the closed orbit feedback system is on and off are shown in Fig. 8. As is shown in Fig. 8, beam orbit stability when the closed orbit feedback system is on is far better than that when the closed orbit feedback system is off.

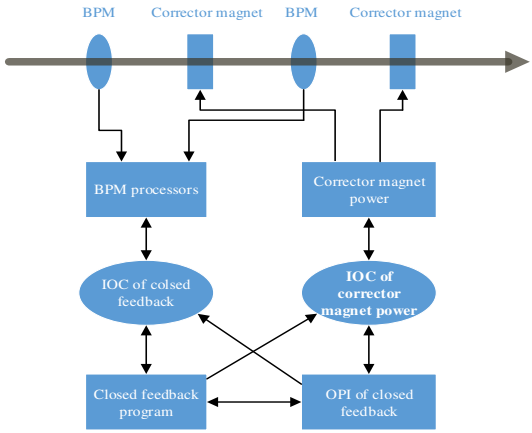

Figure 7: System diagram of the Closed orbit feedback for the HLS II storage ring.

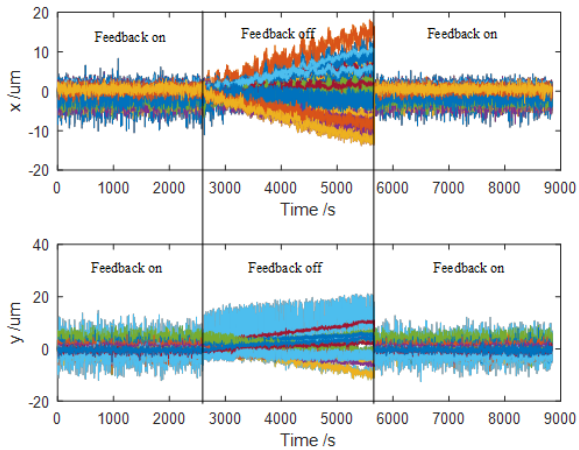

Figure 8: Beam orbit stability when the closed orbit feedback system is on and off.

APPLICATION BASED ON BPM SYSTEM OF THE HLS II STORAGE RING

We have introduced BPM system structure of the HLS II storage ring. Every component of BPM system(BPM, BPM processor embedded with IOC and OPI) have been introduced in detail. Some applications based on BPM system of the HLS II storage ring, such as BBA and beam closed orbit feedback, have been descripted.

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