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REAL-TIME SYNCHRONIZED CALIBRATION AND COMPUTING SYSTEM WITH EPICS BASED DISTRIBUTED CONTROLS IN THE TPS XBPM SYSTEM

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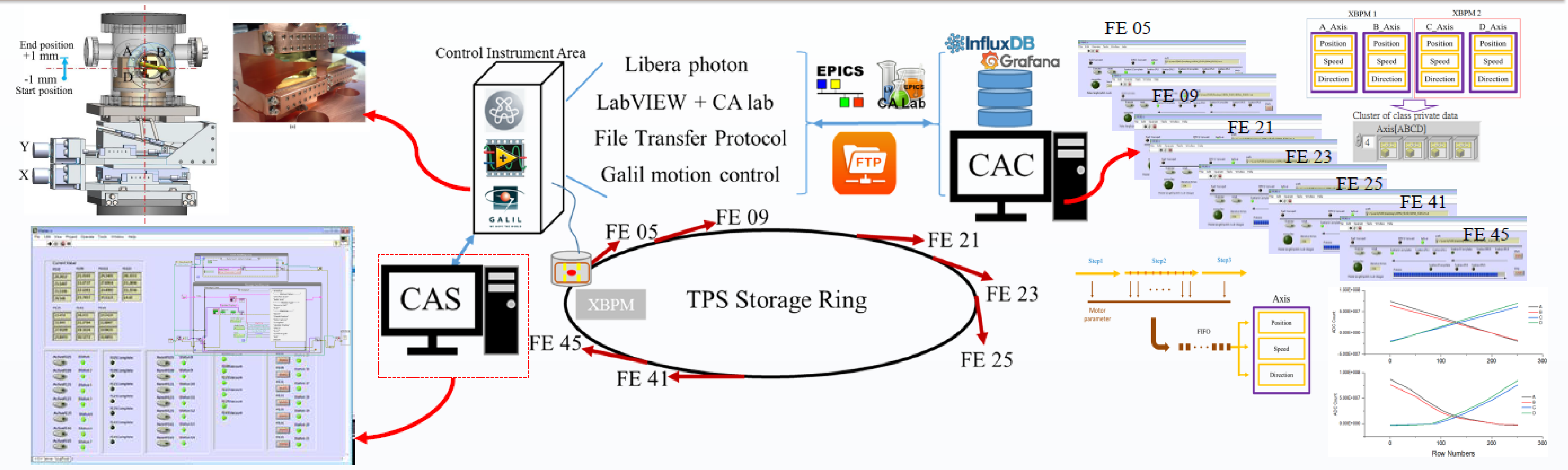
Abstract

In synchrotron facilities, X-ray beam position monitor (XBPM) is an important detector for photon beam position monitoring and must be calibrated to ensure reliability and precision. However, light source operating conditions, such as beam orbit, injection and insertion device parameters, etc., can influence the sensitivity and specific weighting of photoemission current from the XBPM diamond blades. In the Taiwan Photon Source (TPS), Experimental Physics and Industrial Control System (EPICS) was utilized to implant an automatic calibration process. By using EPICS, we can ensure a seamless integration between the different front ends (FEs) and direct all data stream into a centralized server, creating a distributed XBPM calibration system. The XBPM performance indicators are analyzed to evaluate the validity of calibration parameters by input/ output controller (IOC) in each FE computing system. This paper will discuss the benefits of implanting this distributed control system into a working environment such as the TPS.



The XBPM scanning control system consists of a two-dimensional translation stage to move the XBPM along the X and Y-axis. The signals from the four-diamond blades transmit photoemission current signals by standard 50-ohm coaxial cables to the data acquisition Libera photon controller which calculates the X and Y positions to be published as process variables (PVs) by the EPICS on the TPS instrument control intranet. The control software which is programmed with the LabVIEW object-oriented software will be described in this section.

Calibration Results

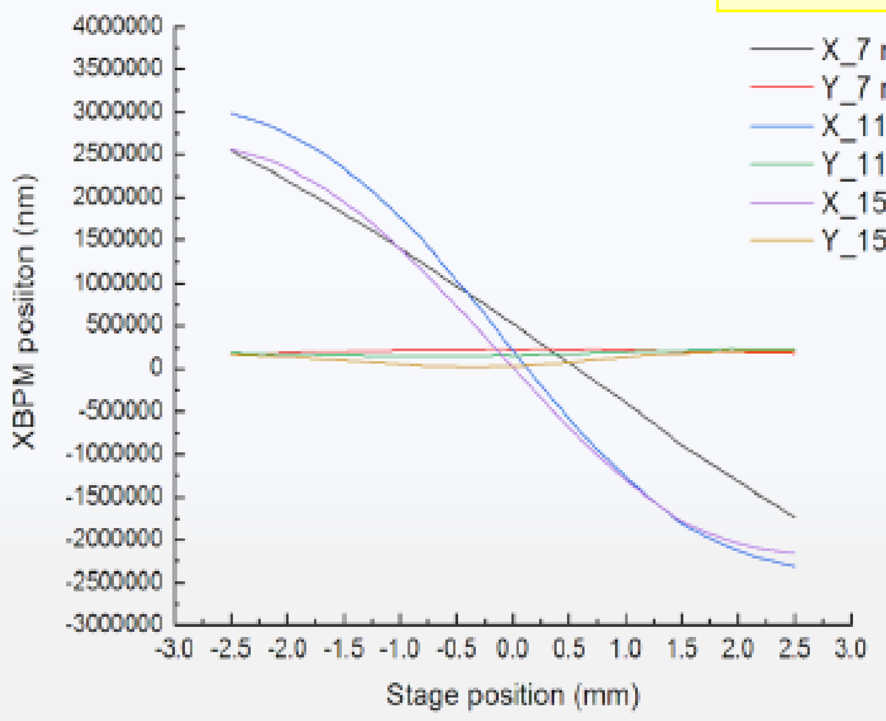


Fig. A: Scanning results before calibration.

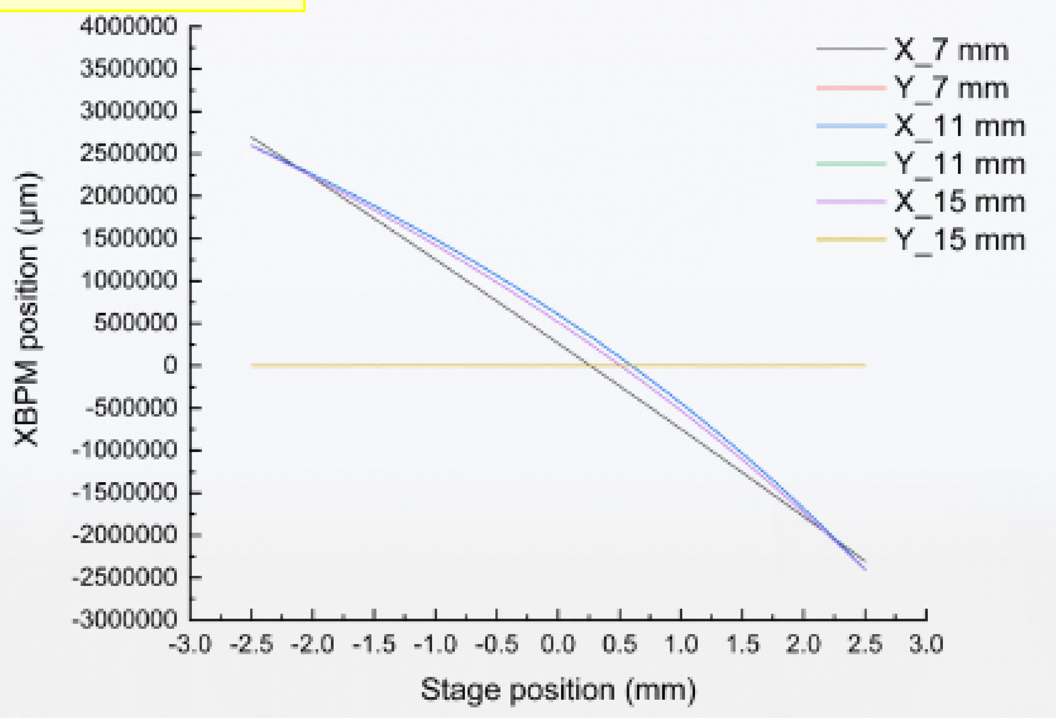


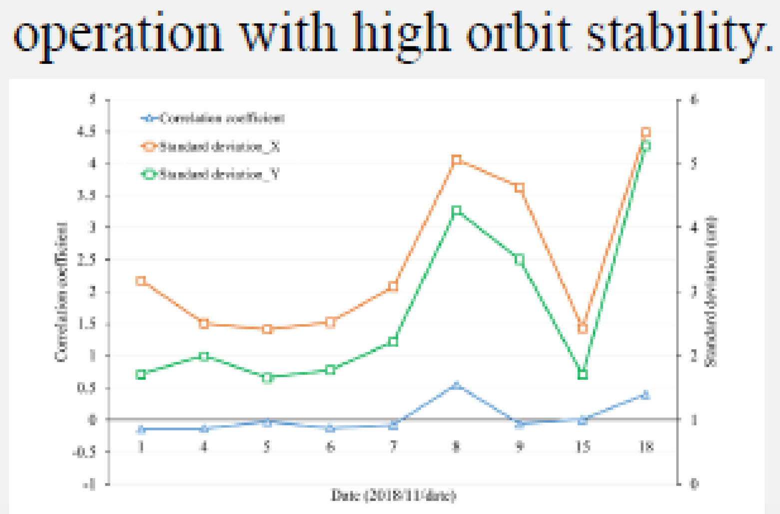
Fig. B: Scanning results after calibration.

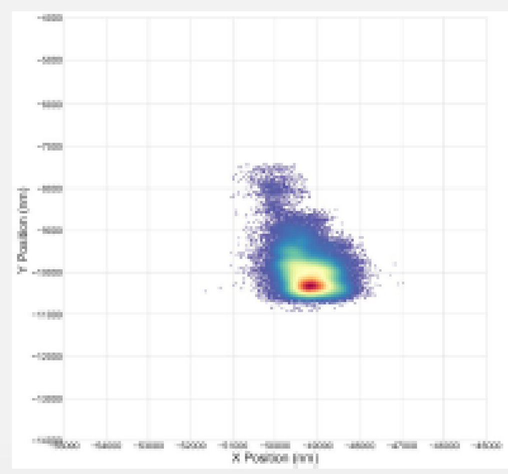
Taking beamline TPS 25A as an example, we show the results before calibration in Fig. A, where the X-axis is the scanning axis and the apparent displacement of the stationary axis Y exhibits a drifting issue. Results after calibration at a gap of 7 mm are shown in Fig. B, where it can be observed that the drift of the stationary axis is effectively suppressed to less than 1 um.

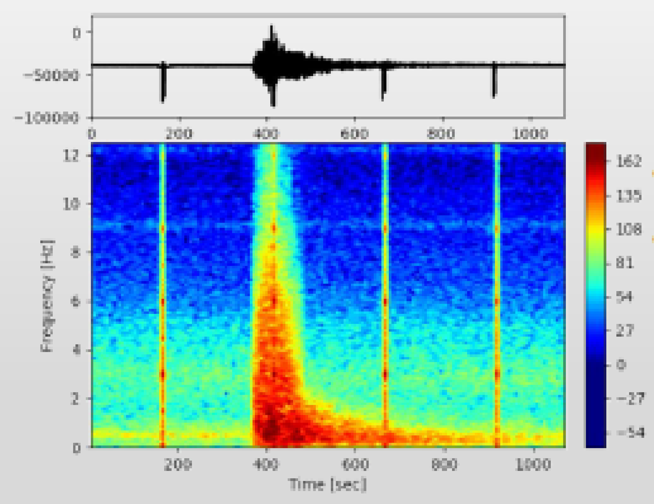
To prove the ID gap effect in the XBPM measurement, we used these results for comparison: While changing the ID gap by 7 mm, 11 mm and 15 mm, the results show that using the same calibration coefficients for 11 and 15mm as for 7 mm, the linearity decreases significantly as shown in Fig. B. Scanning the axis gives linear results only when the gap is 7 mm, while keeping the XBPM calibration parameters, the results for 11 and 15 mm gaps become nonlinear. Using this system enables us to overcome the XBPM precision effect which is caused by variations of operating conditions.

Long term monitor results

The STD is utilized to judge beam stability automatically every hour. If the current position has moved away from the STD by more than 2σ in the past hour, we have reached an alarm point to inform users and send a message to FE staffs' mobile devices by Line Chatbot. To observe the records in figures as bellow, the average STDs, except for injection and non-user time, is less than 5 um, proving a TPS operation with high orbit stability.







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