Virtual Accelerator at NSLS II Project * MOPPC156

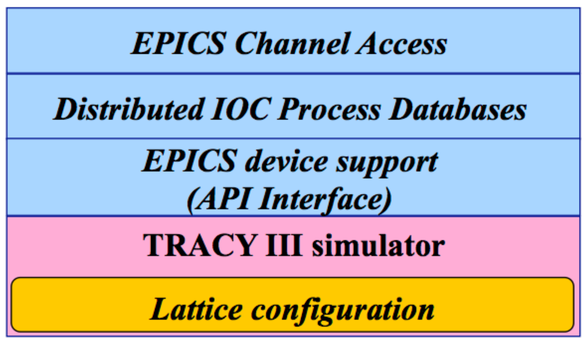
G. Shen (shengb@bnl.gov), L. Yang, Y. Li
BNL, Upton, NY 11973, U.S.A.

Abstract

A virtual accelerator, which has been name as J.M.S. server, has been developed and deployed at NSLS II project at its early stage. This J.M.S. server was pioneered at Diamond Light Source, and improved significantly at NSLS II project. All major accelerator magnets are supported properly like bending, quadrupole, sextupole, RF, and insertion device. The J.M.S. servers have been effectively supporting the tools development such as physics applications, and middle layer services. This paper presents the latest status of virtual accelerator, and our plan for its future development and deployment

System Architecture

An EPICS device support has been developed, and the J.M.S. can be accessed thru EPICS system. All setting and results are available as an EPICS PV It uses TRACY III C++ library as its physics calculation engine.

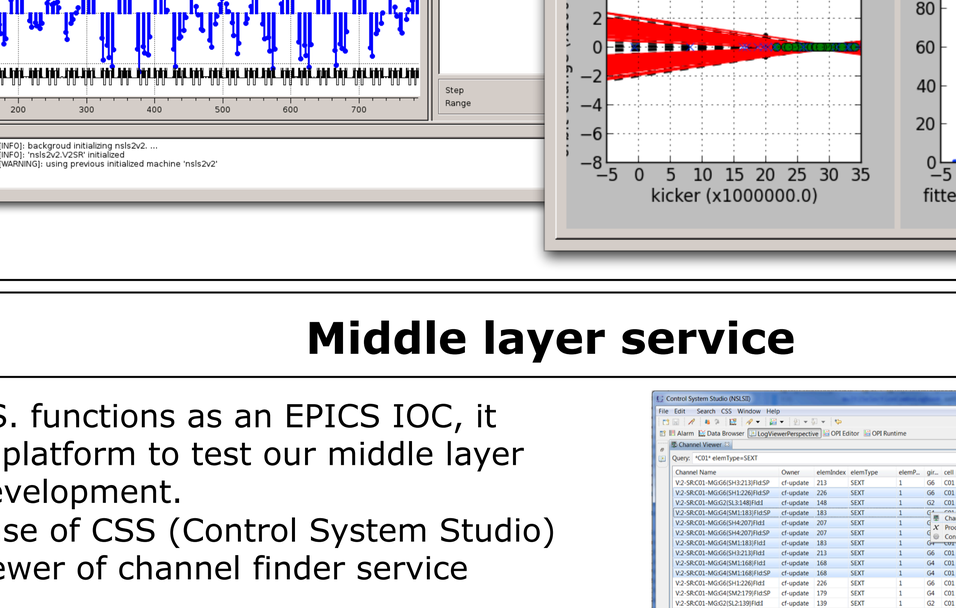


Error emulation

2 mechanism are applied in the J.M.S. server to emulate an error:
- Hardware noise, implemented thru an EPICS calc record by adding a random error to setting;
- Alignment error by initializing TRACY-III during launching J.M.S. server.

Insertion device support

The 2nd order radia kickmaps are used to simulate IDs in TRACY-III simulator. The first and second field integrals from the measurement are simulated by four virtual kicks (two for each plane) located at the ID extremities as shown with red arrows in Fig. 3. The closed orbit distortion due to the imperfection of ID will be compensated by four on-board correctors (as show in green). The calibration function of corrector strength to realize this feed-forward compensation has been successfully implemented and tested on the virtual machine. In the next step, we will use different kickmaps to simulate an ID at different statuses (gap/phase) to calibrate other feed-forward tables if necessary.



EPICS DB Generating

A PyQt based UI is developed to generate EPICS runtime database automatically. User could load in a TRACY-III lattice file, and generate a EPICS db as shown in Fig 2.

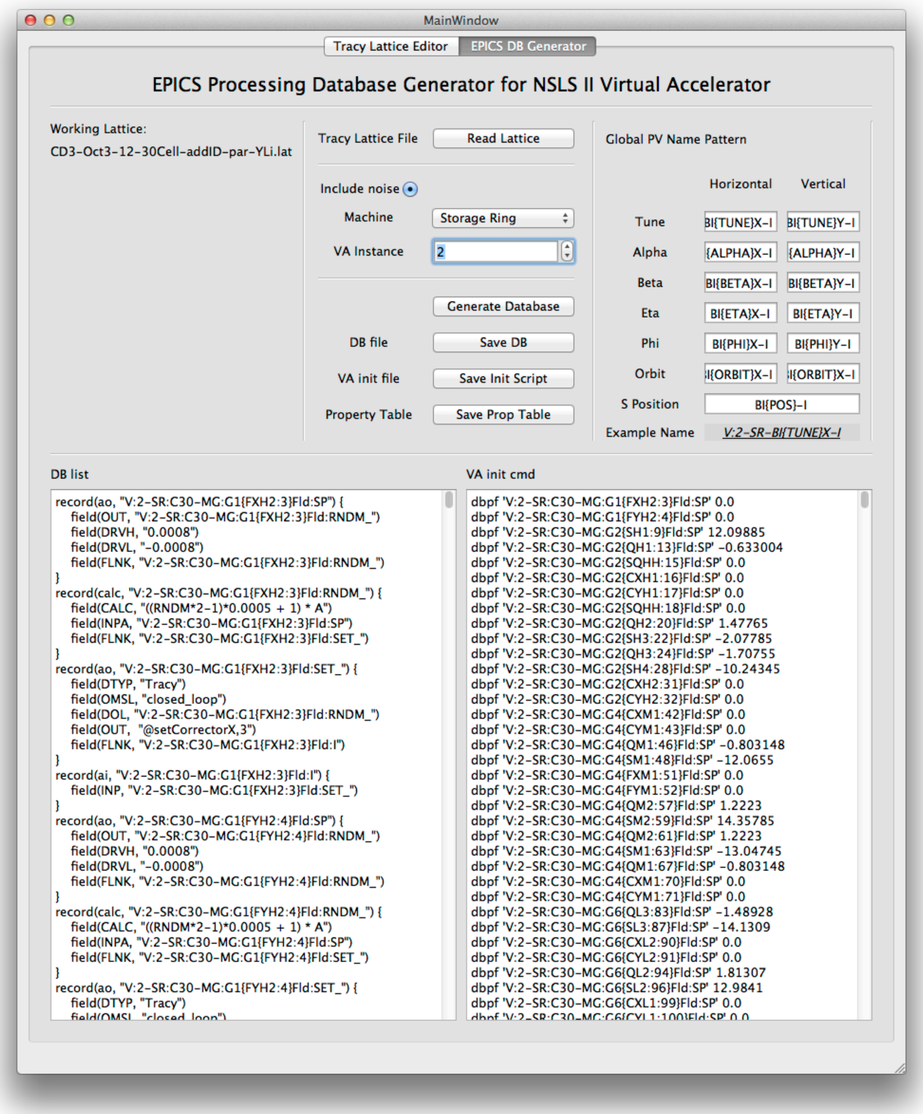
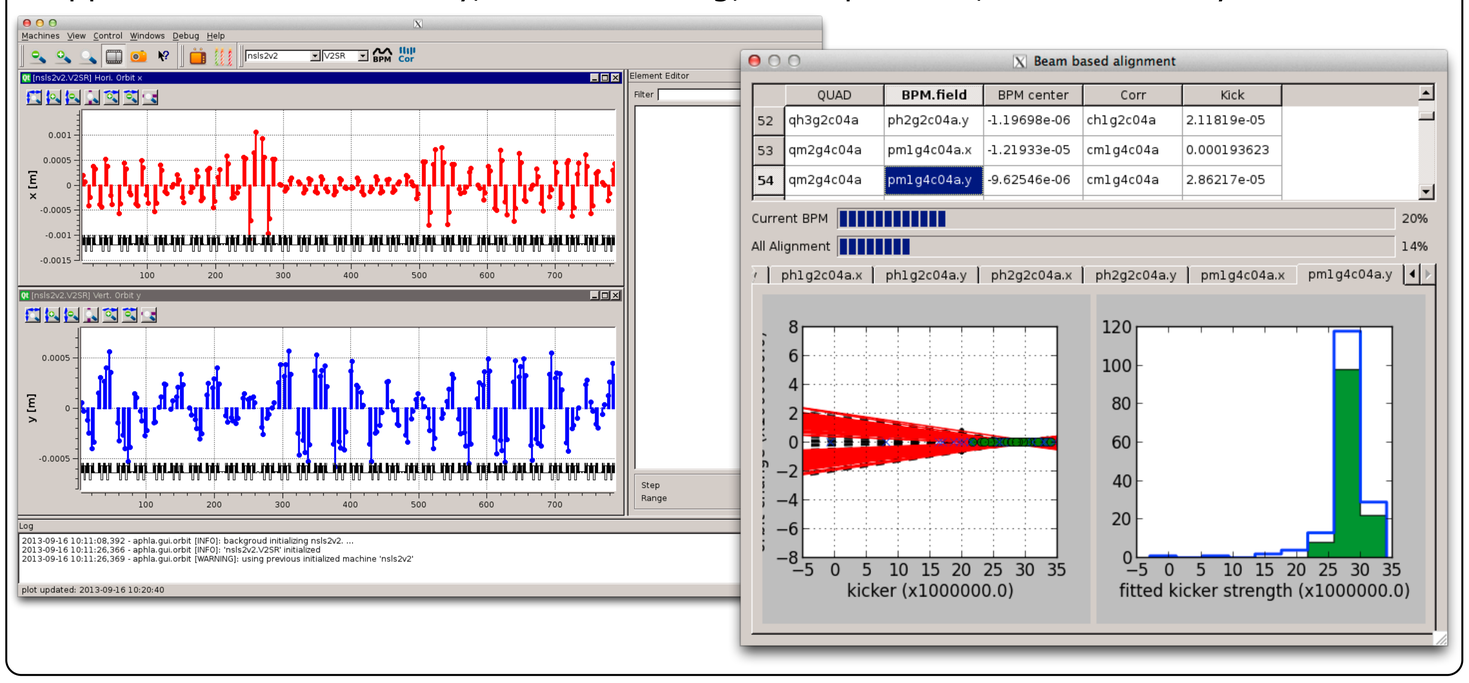


Figure 2: Tool to generate EPICS DB from lattice

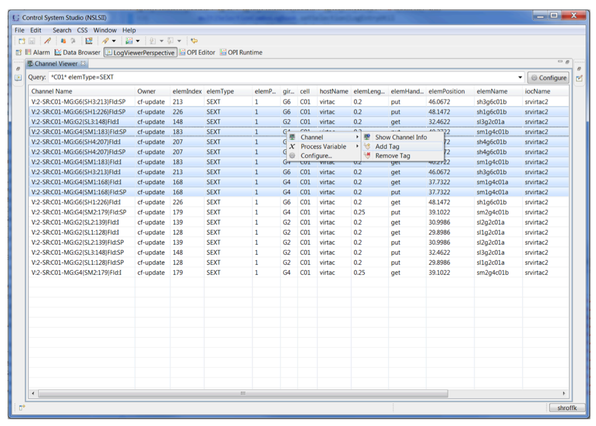
High level application

- The J.M.S. server provides a solid ground to development of high level physics application for beam study, commissioning, and operation, and middle layer service.



Middle layer service

Since J.M.S. functions as an EPICS IOC, it provides a platform to test our middle layer services development.
One use case of CSS (Control System Studio) channel viewer of channel finder service



Summary

5 J.M.S. servers deployed at NSLS II project, (1) Transport line for Linac to beam dump 1 (LBD1); (2) Transport line for Linac to beam dump 2 (LBD2); (3) Linac to booster ring transport line (LBT); (4) Storage ring with insertion devices (V2); (5) Storage ring one turn beam study (V3). V2 is most complicated, which has 12 insertion devices with 2nd order kick-map. However, it achieved a performance with about 1Hz repitition rate.

Acknowledgments

Special thanks to James Rowland at Diamond Light Source, who made original development to this virtual accelerator. James Rowland died in Nov 2012; to memorize his significant contributions to this work, this virtual accelerator has been named the J.M.S.[9].

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