Contribution ID: **56** Type: **not specified**

Development of beam correction techniques based on feed forward neural networks for electron storage ring Solaris

Tuesday 20 June 2023 09:30 (30 minutes)

National Synchrotron Radiation Center SOLARIS is third generation synchrotron light source located in Krakow, Poland. It is the only operator of synchrotron light source in Poland. SOLARIS consists of a linear accelerator, 1.5 GeV storage ring with 96 m circumference, six operating beamlines and three more under construction. The storage ring accelerates the electron beam from injection (approx. 550 MeV) to its final 1.5 GeV energy and stores the circulating electron beam for many hours on a stable orbit providing beamlines access to the synchrotron radiation used for research. The Solaris storage ring uses 36 buttons beam position monitors (BPMs) with commercial electronics from Instrumentation Technologies –Libera Brilliance+, 36 horizontal and 36 vertical correctors that are mounted as extra coils on correction sextupoles. The maximum kick angle of those correctors is 0.25 mrad which corresponds to 10 A power supply current setting. The slow orbit feedback (SOFB) correction is performed by the method of singular value decomposition (SVD). Due to the presence of three insertion devices (undulators), SOFB is supplemented with feedforward correction which manages corrector coils installed on undulators (4 per one).
We plan to use artificial neural network models based on python in the process of designing the network interface and using GPUs in order to apply the model in real time. We expect that thanks to the use of ML we will save the time needed to perform scans, and the saved time will be allocated to experimental beamlines and further development of the center.
The implemented method will also grant us access to valuable diagnostic information in real time, due to the comparison of the magnet reaction to the changing electron orbit. This will give us the possibility to detect magnet or beam position monitor malfunctions within the electron storage ring.
The signals used to teach the neural network will be the readings from the BPMs, corrector electromagnets, the present and set positions of the gaps and the phases of the undulators.
In the scope of this talk, tests of a LSTM based ANN will be presented, with the use of data stored in tango. Anomaly detection, response matrix and undulator correction tables will be presented and the first steps towards full ML based beam correction.

Summary

Primary author: BIERNAT, Jacek (NCPS SOLARIS)

Presenter: BIERNAT, Jacek (NCPS SOLARIS)

Session Classification: Session 3