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Online monitor for the proton storage ring via convolutional neural network

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The Proton Storage Ring (PSR) of the Los Alamos Neutron Science Center (LANSCE) accumulates a 625-us-long beam and compresses into a 290-ns-long (base-to-base) short pulse for the Lujan Center. For operation, due to the high-intensity nature, the PSR also serves as the most sensitive "diagnostics" for the accelerator operation. The changes in the PSR losses are more sensitive than any other diagnostics to drifts in the linac. Therefore, continuous maintaining and characterizing the PSR is critical. However, the PSR operation is predominantly loss-guided while key physics parameters, like the betatron tune, closed-orbit, injection offsets, and etc, are only measured once per day. The beam position monitors (BPMs) only made meaningful measurements with single 290-ns-long injection, causing a downtime for each measurement. However, recent upgrade to the data-acquisition system and also the chopper system allows continuous measurements during operation. In this work, we use Convolutional Neural Network to infer key physics parameters based on simulated data. This will be tested and implemented in the 2025 run cycle.

Footnotes

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Author: HUANG, En-Chuan (Los Alamos National Laboratory)

Co-author: ANISIMOV, Petr (Los Alamos National Laboratory)

Presenter: HUANG, En-Chuan (Los Alamos National Laboratory)

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