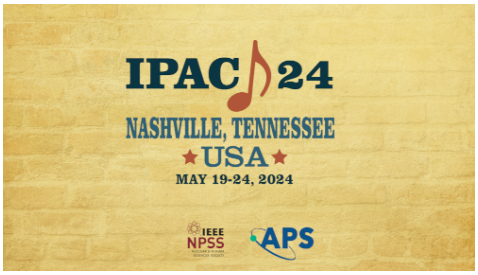

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Machine-learning based extraction of longitudinal beam parameters in the LHC

Tuesday, 21 May 2024 16:00 (2 hours)

Accurate knowledge of beam parameters is essential for optimizing the performance of particle accelerators like the Large Hadron Collider (LHC). An initial machine-learning (ML) model for the reconstruction of the longitudinal distribution has been extended to extract the main parameters of multiple bunches at LHC injection. The extended model utilizes an encoder-decoder architecture to analyze sets of longitudinal profile measurements. Its development was partially driven by the need of a real-time beam energy error estimate, which was not directly available in the past. The derived beam parameters moreover include injection phase error, bunch length and intensity in the LHC, as well as the RF voltages at extraction from the Super Proton Synchrotron (SPS) and at capture in the LHC. In this paper, we compare the results of the ML model with conventional measurements of bunch length and energy error, from the beam quality monitor (BQM) and the orbit acquisition system, respectively. These benchmarks demonstrate the potential of applying the ML model for operational exploitation in LHC.

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