

Apply Machine Learning in Orbit Control and Accelerator Stabilization

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Orbit control in the NSLS-II facility of Brookhaven National Laboratory (BNL) plays a crucial role in controlling the stability of electron beams. A traditional slow orbit feedback (SOFB) approach relies on a pseudo-inverse of the linear orbit response matrix and transforms the beamline position to the output control correctors. This method can suppress the short-term orbit noises but cannot robustly retain the beam in the reference orbit position when nonlinear effects exist between correctors and the electron beam position monitors (BPM). Sunrise Technology Inc., in collaboration with BNL, applied multiple machine-learning enabled approaches to this multi-input multi-output (MIMO) system with a large (180x180) input and output dimensions, and confirmed that several methods outperformed the traditional system with smaller residual orbit errors. Our algorithm will reduce the long-term drifts of the electron beam orbit and ensure the system is more adaptive to environmental changes.