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Insertion device correction based on machine learning models at the MAX IV 3 GeV ring

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Insertion Devices (ID) in particle accelerators introduce orbit distortions that must be compensated. At MAX IV, this compensation traditionally relies on feed-forward tables which are time-consuming to measure, and sensitive to changes in accelerator settings. This study explores the use of machine learning (ML) to automate the generation of feed-forward tables without requiring extensive measurements. Using archived data from ID gaps, beam position monitors (BPM), and corrector magnets, a neural network-based model was developed to replicate the current ID compensation system. Preliminary results show that the model effectively reproduces the existing compensation behavior and suggests potential for adaptive feed-forward tables that refine themselves with online data. In parallel, alternative ML approaches focused on minimizing beam position errors are being investigated. These efforts aim to improve the maintainability of ID compensation and prepare orbit control for future optical changes and new operational scenarios.

Footnotes

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Author: TAKAHASHI, Carla (MAX IV Laboratory)

Co-authors: AL MEDAWER, Adnan (MAX IV Laboratory); HOLZ, Michael (MAX IV Laboratory); TARAWNEH, Hamed (MAX IV Laboratory); MURADI, Mostafa (MAX IV Laboratory)

Presenter: HOLZ, Michael (MAX IV Laboratory)

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