Contribution ID: **102** Contribution code: **MOP056** Type: **Poster Presentation**

Machine learning assisted Bayesian calibration of accelerator digital twin from orbit response data

Monday 11 August 2025 16:00 (2 hours)

Digital twins of particle accelerators are used to plan and control operations and design data collection campaigns. However, a digital twin relies on parameters that are hard to measure directly, e.g., magnet alignments, power supply transfer functions, magnet nonlinearities, and stray fields. These parameters can be constrained by beam position and profile measurements. We use Bayesian statistical inference to estimate the parameters, and their uncertainties, probabilistically by calibrating the Bmad digital twin to beam measurements. The inference is computationally accelerated using a machine learning emulator of the physical accelerator digital twin trained to a perturbed-parameter ensemble of Bmad simulations. The result is a joint posterior distribution over parameters (control currents, individual magnet transfer function coefficients, and beam monitor errors) which is propagated to uncertainties in predicted beam positions and profiles, which we validate against beam responses measured at the AGS booster at Brookhaven National Laboratory.

Please consider my poster for contributed oral presentation

Yes

Would you like to submit this poster in student poster session on Sunday (August 10th)

No

Footnotes

Funding Agency

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I have read and accept the Privacy Policy Statement

Yes

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