Contribution ID: **429** Type: **Poster Presentation**

Towards Accurate Beam Sigma Matrix Determination in a Transport Line Using Differentiable Simulation

Precise characterization of the beam distribution is essential for matching the incoming beam and optimizing injection into storage rings. We present a method to efficiently reconstruct the full 5×5 beam sigma matrix (excluding the time coordinates) at the booster-to-storage-ring (BTS) transport line at the Advanced Photon Source Upgrade (APS-U). Earlier works demonstrated that the beam sigma matrix can be accurately reconstructed using linear transport matrices under the assumption of negligible chromatic effects. However, the presence of chromaticity introduced significant non-linearities and leads to discrepancies from the linear approaches.

In this work, we demonstrate a novel approach leveraging Cheetah, a differentiable beam dynamics simulation framework, to enable direct gradient-based optimization of the beam matrix. Initial results shows efficient and accurate reconstruction under both linear and second-order tracking models, providing improved robustness in simulation studies. This method offers a scalable, interpretable, and computationally efficient alternative to black-box methods for beam matrix reconstruction in transport lines in presence of complex effects.

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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Yes

Author: XU, Chenran (Argonne National Laboratory)

Co-authors: EMERY, Louis (Argonne National Laboratory); BORLAND, Michael (Argonne National Laboratory); MOHSEN, Osama (Argonne National Laboratory); ROUSSEL, Ryan (SLAC National Accelerator Laboratory); SUN, Yine (Argonne National Laboratory)

Presenter: XU, Chenran (Argonne National Laboratory)

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