Contribution ID: **158** Contribution code: **TUP033** Type: **Poster Presentation**

Efficient phase space density construction via transfer operators

Tuesday 12 August 2025 16:00 (2 hours)

Optimizing accelerator lattices requires evaluating phase space densities through extended or repeated particle-in-cell simulations. These are computationally expensive due to the need to solve the equations of motion for large numbers of charged particles in prescribed and self-consistent fields. We introduce a method that significantly reduces the computational burden by constructing approximate invariant densities via a two-step transfer operator approach. The method gives practical approximations to phase-space level curves, capturing essential dynamics without extensive particle pushing. Prior work has shown how to find such curves via kernel-based level set learning. *Our method is fast, avoids kernel tuning, and integrates with existing codes, enabling rapid assessment of figures of merit in constrained optimization algorithms such as Adjoint with a Chaser, AWC**. AWC efficiently computes gradients with respect to lattice parameters while preserving moment periodicity and accounting for self-fields and collective effects. We present results demonstrating accuracy, speed-up, and trade-offs between precision and computational cost in lattice design.

Please consider my poster for contributed oral presentation

No

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

Yes

Footnotes

- M. Ruth and D. Bindel, Level set learning for Poincaré plots of symplectic maps, SIAM Journal on Applied Dynamical Systems 24, 611 (2025). ** Adjoint Optimization of Circular Lattices T.M. Antonsen, L. Dovlatyan, A.K. Einarsson, I. Haber, P.G. O'Shea, P.G. O'Shea (UMD) NAPAC 2022. https://attend.ieee.org/napac-2022/

Funding Agency

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