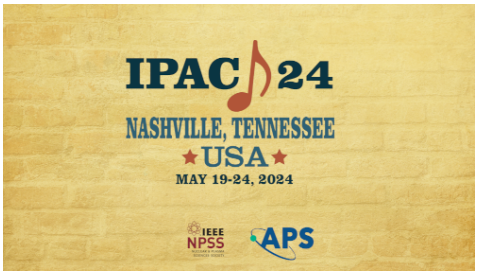

Contribution ID: **1709** Contribution code: **TUPS28** Type: **Poster Presentation**

Linac_Gen: integrating machine learning and particle-in-cell methods for enhanced beam dynamics at Fermilab

Tuesday, 21 May 2024 16:00 (2 hours)

Here, we introduce Linac_Gen, a tool developed at Fermilab, which combines machine learning algorithms with Particle-in-Cell methods to advance beam dynamics in linacs. Linac_Gen employs techniques such as Random Forest, Genetic Algorithms, Support Vector Machines, and Neural Networks, achieving a tenfold increase in speed for phase-space matching in Linacs over traditional methods, through the use of genetic algorithms. Crucially, Linac_Gen's adept handling of 3D field maps elevates the precision and realism in simulating beam instabilities and resonances, marking a key advancement in the field. Benchmarked against established codes, Linac_Gen demonstrates not only improved efficiency and precision in beam dynamics studies but also in the design and optimization of Linac systems, as evidenced in its application to Fermilab's PIP-II Linac project. This work represents a notable advancement in accelerator physics, marrying ML with PIC methods to set new standards for efficiency and accuracy in accelerator design and research. Linac_Gen exemplifies a novel approach in accelerator technology, offering substantial improvements in both theoretical and practical aspects of beam dynamics.

Footnotes

Funding Agency

Work supported, in part, by the U.S. Department of Energy, Office of Science, Office of High Energy Physics, under U.S. DOE Contract No. DE-AC02-07CH11359

Paper preparation format

LaTeX

Region represented

North America

Primary author: PATHAK, Abhishek (Fermi National Accelerator Laboratory)

Presenter: PATHAK, Abhishek (Fermi National Accelerator Laboratory)

Session Classification: Tuesday Poster Session

Track Classification: MC4: Hadron Accelerators: MC4.A16 Advanced Concepts