Contribution ID: **42** Contribution code: **WECI01** Type: **Invited Oral Presentation**

Machine Learning-based beam sculpting and measurement using a multileaf collimator and emittance exchange

Wednesday 10 September 2025 13:00 (30 minutes)

This paper presents a novel, rapidly reconfigurable multileaf collimator (MLC) for high-fidelity beam shaping. The MLC, compatible with ultra-high vacuum, features independently actuated leaves to tailor mask profiles. Coupled with an emittance-exchange (EEX) beamline at the Argonne Wakefield Accelerator, transverse profiles are transformed into custom longitudinal distributions, including ramped beams. We demonstrate various measurements of tailored beam profiles, both transverse and longitudinal. A new, rotor-based design increases flexibility, and a feed-forward control algorithm enables on-demand shaping. Machine learning optimizes MLC degrees of freedom for applications like FEL gain or wakefield accelerator performance, and adapts beam parameters in real-time to changing accelerator conditions. This versatile beam sculpting instrument has broad relevance for next-generation accelerators across FEL, AAC, and hadron-beam communities.

Footnotes

Funding Agency

I have read and accept the Conference Policies

Yes

Author: MAJERNIK, Nathan (SLAC National Accelerator Laboratory)

Presenter: MAJERNIK, Nathan (SLAC National Accelerator Laboratory)

Session Classification: WEC

Track Classification: MC08: Machine Parameter Measurements