

High-dimensional characterization of coherent synchrotron radiation effects using generative-model-based phase space reconstruction methods

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Coherent synchrotron radiation (CSR) is a detrimental effect in linear accelerators due to its contribution to projected emittance growth and microbunching. However, conventional measurement techniques are not precise enough to resolve the exact multi-dimensional effects of CSR, namely the different rotation of transverse phase space slices throughout the longitudinal coordinate of the bunch. In this work, we investigate the applicability of our generative-model-based six-dimensional phase space reconstruction method in the detailed characterization of CSR effects at the Argonne Wakefield Accelerator Facility. Additionally, we study the current resolution limitations of the phase space reconstruction method and perform an analysis of its accuracy and precision in simulated cases. Finally, we test the reconstruction algorithm with synthetic beams that approximate distributions affected by CSR.

Primary Keyword

differentiable models

Secondary Keyword

Tertiary Keyword

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