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Generalization ability of convolutional neural networks trained for coherent synchrotron radiation computations

Monday 26 August 2024 16:00 (2 hours)

Coherent synchrotron radiation has a significant impact on electron storage rings and bunch compressors, inducing energy spread and emittance growth in a bunch. Calculating the effects are computationally expensive, severally limiting the use of simulations. Here, we explore utilizing neural networks (NNs) to model the 3D wakefields of electrons in circular orbit in the steady state condition. NN models were trained on both Gaussian and more general bunch distributions, which evaluate much faster than physics-based simulations. Here, we explore how well the models generalize, by testing their ability to 1) extrapolate to Gaussians with smaller/larger widths 2) predict on distributions never encountered before (out of distribution generalization) using smoothed uniform cubes. We see the models are able to generalize, which makes them potentially useful in the design and optimization of accelerator apparatuses by enabling rapid searches through parameter space.

Footnotes

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