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Machine learning and Bayesian optimization for pulse shaping on a linear induction accelerator

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The Advanced Sources and Detectors project is building an advanced multi-pulse linear induction accelerator capable of generating a 1.4 kA electron beam at energies up to 24 MeV. The accelerator, named Scorpius after the brightest known x-ray source in the sky, will be unique in its use of solid-state pulsed power (SSPP) to generate the voltage pulse for the injector and accelerating gaps throughout the accelerator, giving Scorpius unique control of the pulse shape by independently triggering 45 individual stages stacked in each of nearly 1,000 line replaceable units (LRUs). To take full advantage of the SSPP flexibility, automated optimization of the pulse shape to a desired waveform is currently under development. To demonstrate this capability, non-linear surrogate circuit models of the SSPP have been developed using the hybrid transmission line/modified nodal analysis code, CASTLE, that include parasitics and a dummy load to generate reflections. Data-efficient Bayesian optimizations calling CASTLE directly for each iteration are compared with results from a convolutional neural network or other machine learning model trained on data generated by CASTLE, and the effect of the number of stages on pulse flattening is discussed.

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Footnotes

I have read and accept the Privacy Policy Statement

Yes

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