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Fast linac optics measurement with machine learning methods

Thursday 29 August 2024 16:00 (2 hours)

Optics measurement is a common tuning and troubleshooting task which takes up a large amount of APS linac machine study time. It is of interest to explore more efficient methods to increase its'speed and data quality. We previously tested Bayesian inference for determining linac magnet parameters, and in this work extend the method to directly measure linear optics and nonlinear deviations. We rely on differentiable simulations to define a loss that describes the disagreement of the model and experimental data, which can then be minimized using standard ML methods. Alternatively, MCMC approaches can be used for direct sampling. We demonstrate the usefulness of our method by estimating Twiss parameters and detecting misconfigured magnets using significantly fewer measurements than standard tools. We also show how this analysis can be performed parasitically to user operation, which we hope can be used for a live optics model diagnostic and subsequent anomaly detection, improving injector reliability.

Footnotes

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