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Ryan Roussel

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Tuesday, April 5th, 2022
12:00 PM – 1:00 PM

Register in advance for this meeting:

https://bnl.zoomgov.com/
meeting/register/
vJItceqgpjkrEoO_jckF4MCANpw
AWRuB6oc

Host: Meifeng Lin

Differentiable Preisach Modeling for Particle Accelerator Systems with Hysteresis

Abstract: Future improvements in particle accelerator performance are predicated on increasingly accurate online modeling of accelerators. Hysteresis effects in magnetic, mechanical, and material components of accelerators are often neglected in online accelerator models used to inform control algorithms, even though reproducibility errors from systems exhibiting hysteresis are not negligible in high precision accelerators. In this work, we combine the classical Preisach model of hysteresis with machine learning techniques to efficiently create non-parametric, high-fidelity models of arbitrary systems exhibiting hysteresis. We also experimentally demonstrate how these methods can be used in-situ, where the hysteresis model is combined with a Bayesian statistical model of the beam response, allowing characterization of hysteresis in accelerator magnets solely from measurements of the beam. Furthermore, we explore how using these joint hysteresis-beam models allows us to overcome optimization performance limitations when hysteresis effects are ignored.

Bio: Ryan Roussel obtained his PhD from UCLA in 2019 working on high transformer ratio plasma wakefield acceleration. Before joining SLAC as an associate staff scientist he worked at the University of Chicago developing machine learning based optimization algorithms for both simulated and experimental particle accelerators. His research interests include Bayesian optimization techniques for accelerators and differentiable physics simulations.