Karlsruhe Institute of Technology

Case Study: Active Learning for Building Accelerator Surrogate Models

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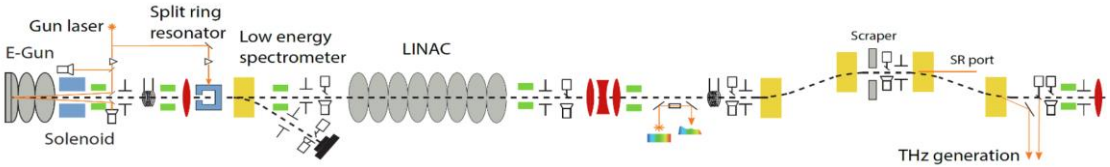
Data Generation WG, Trainable 23 Workshop

Motivation: RL Control at FLUTE

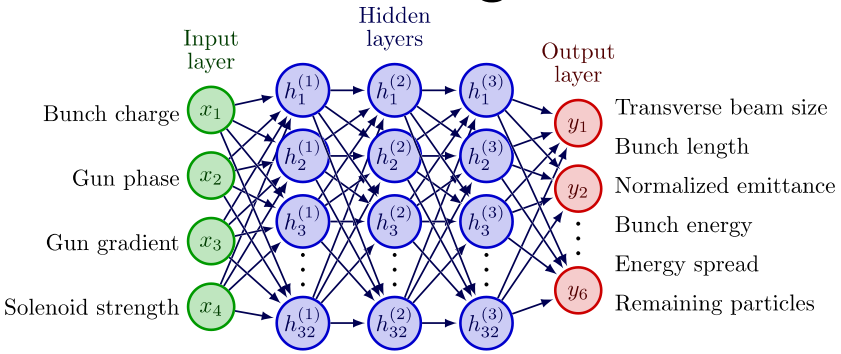
Linac-based test facility for accelerator R&D

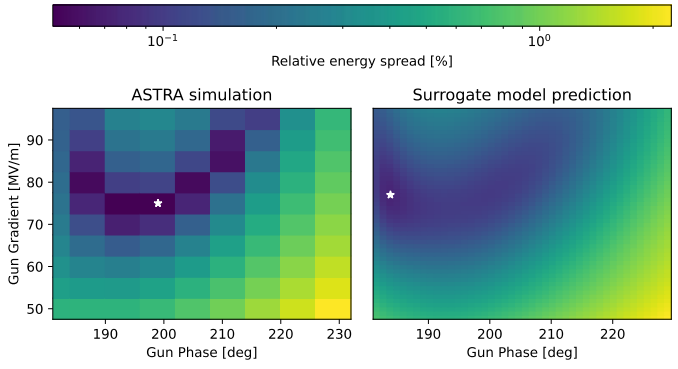


Optimal electron energy	~ 41	MeV
Electron bunch charge	0.001 - 1	nC
Electron bunch length	1 - 300	fs
Pulse repetition rate	5	Hz
THz E-Field strength	up to 1.2	GV/m

Goal: Reinforcement learning-based THz radiation control and optimization
Challenge: Pre-training RL agents takes a lot of samples (~ 1e6), tracking simulations are not fast enough.

Previous: Surrogate Model with Grid Scan Data

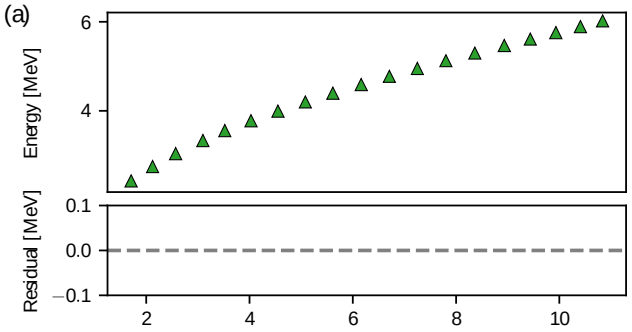


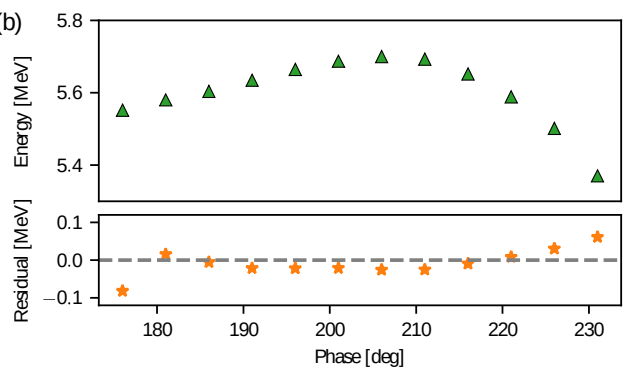


1 min

1 ms

Great agreement with measurements:





measurement

simulation

surrogate model

C. Xu et al. TUPOPT070, IPAC2

Outlook: Active Learning

- Grid scan scales exponentially with # input parameters
- Use active learning methods to scale to start-to-end FLUTE surrogate model

- # input parameters: ~10
- # output parameters: beam parameters at different stages + radiation properties