What are you trying to do?

Problem definition:

Reduce beam losses in the FNAL Booster by developing a Machine Learning (ML) model that provides an optimal set of actions for accelerator controls

FNAL Accelerator Complex:



Courtesy: Christian Herwig



What is new in your approach and why do you think it will be successful?





Reinforcement learning FNAL Booster workflow

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Who cares?

- DOE HEP and FNAL
- Other accelerator complexes

If you are successful, what difference will it make?

Improved operations

How long will it take?

• 2-3 years





Test



Train

Thank you

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Real-time artificial intelligence for accelerator control: A study at the Fermilab Booster

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We describe a method for precisely regulating the gradient magnet power supply (GMPS) at the Fermilab Booster accelerator complex using a neural network trained via reinforcement learning. We demonstrate preliminary results by training a surrogate machine-learning model on real accelerator data to emulate the GMPS, and using this surrogate model in turn to train the neural network for its regulation task. We additionally show how the neural networks to be deployed for control purposes may be compiled to execute on field-programmable gate arrays (FPGAs), and show the first machine-learning based control algorithm implemented on an FPGA for controls at the Fermilab accelerator complex. As there are no surprise latencies on an FPGA, this capability is important for operational stability in complicated environments such as an accelerator facility.

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