



Contribution ID: 33

Type: **(b) Poster abstract only (one author must be in person)**

## **Autoencoder Style Neural Networks for Estimation and Control with Unknown Time Varying Parameters**

*Thursday, June 13, 2024 6:43 PM (1 minute)*

We demonstrate the use of an autoencoder style generative neural network (NN) architecture on problems in the estimation and control of accelerators. Using HPSim, a high-performance particle tracking code, we generate datasets and train a NN to map from accelerator tuning parameters and the initial condition to measurements of interest, like phase space projections and beam loss, as well as reproducing the initial condition itself. We assume that certain outputs of the NN, like beam loss, can be measured from a real accelerator system, which can be compared with the NN prediction to generate an error signal. This error signal can be used to estimate quantities like the initial condition and phase space projections – even after training when these quantities change over time and cannot be measured. We also show how this method can be used to perform control actions to tune the beam.

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**Session Classification:** Poster session

**Track Classification:** Physics, Experiments and Detectors: Software