Applications of Neural Networks for Anomaly Detection in Particle Accelerators*

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Abstract

Over the past two years, machine learning and neural networks have seen a significant increase in popularity for particle accelerator applications. Anomaly detection is of particular interest due to the need to quickly diagnose faults when the machine is operating and to minimize down time through predictive fault detection. In this talk we present two approaches that utilize unsupervised learning and neural networks for anomaly detection. First, we use autoencoders to build compact representations of magnet data from the APS storage ring during normal operations. We then use these autoencoders to detect precursors to magnet failures in the ring. Our second approach uses inverse models that relate beam position monitor readings to corrector magnet settings in order to detect errors in quadrupole magnets. For this approach, we will discuss a simple FODO example and then present recent results on simulations of the AGS to RHIC transfer line.

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