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Interaction Network Autoencoder in the Level-1 Trigger

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At the LHC, the FPGA-based real-time data filter system that rapidly decides which collision events to record, known as the level-1 trigger, requires small models because of the low latency budget and other computing resource constraints. To enhance the sensitivity to unknown new physics, we want to put generic anomaly detection algorithms into the trigger. Past research suggests that graph neural network (GNN) based autoencoders can be effective mechanisms for reconstructing particle jets and isolating anomalous signals from background data. Rather than treating particle jets as ordered sequences or images, interaction networks embed particle jet showers as a graph and exploit particle-particle relationships to efficiently encode and reconstruct particle-level information within jets. This project investigates graph-based standard and variational autoencoders. The two objectives in this project are to evaluate the anomaly detection performance against other kinds of autoencoder structures (e.g. convolutional or fully-connected) and implement the model on an FPGA to meet L1 trigger requirements.

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