Contribution ID: **74** Type: **not specified**

Graph Neural Networks for track reconstruction in ATLAS ITk

Thursday, 14 December 2023 16:35 (10 minutes)

The reconstruction of charged-particle trajectories plays an essential role in High-Energy Physics, as it determines the quality of particle identification, kinematic measurement, vertex finding, lepton reconstruction, and jet flavor tagging. The upcoming High Luminosity phase of the Large Hadron Collider (HL-LHC) represents a steep increase in pileup rate ($\langle\mu\rangle = 200$) and in the computing resources required for offline track reconstruction of the ATLAS Inner Tracker (ITk). Track pattern recognition algorithms based on Graph Neural Networks (GNNs) have been demonstrated as a promising approach to this challenge. We discuss in this contribution a machine learning pipeline developed by the GNN4ITk collaboration in ATLAS, dubbed the GNN4ITk pipeline, which employs a number of deep learning techniques including a GNN architecture for track reconstruction. Using detector simulation of $t\bar{t}$ events on the latest version of ITk geometry with $\langle\mu\rangle = 200$, we demonstrate the performance of this approach, and compare to existing reconstruction algorithms on a range of physics metrics, including reconstruction efficiency, reconstruction in dense environment, and track parameter resolution.

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Session Classification: Lightning Round Talks (2)