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Combined track finding with GNN & CKF

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The application of graph neural networks (GNN) in track reconstruction is a promising approach to cope with the challenges that will come with the HL-LHC. They show both good track-finding performance in high pile-up scenarios and are naturally parallelizable on heterogeneous compute architectures.

Typical HEP detectors have have a high resolution in the innermost layers in order to support vertex reconstruction, but then lower resolution in the outer parts. GNNs mainly rely on 3D space-point information, so this can cause reduced track-finding performance in these regions.

In this contribution we present a novel combination of GNN-based track finding with the classical Combinatorial Kalman Filter (CKF) algorithm to circumvent this issue: The GNN resolves the track candidates in the inner pixel region, where 3D space points can represent measurements very well. These candidates are then seamlessly picked up by the CKF in the outer regions, which performs well even for 1D measurements, where a space point definition is not clearly given.

With the help of the infrastructure of the ACTS project, we will show both a proof-of-concept based on truth tracking in the pixels, that allows to estimate achievable improvements for duplicate and fake rate, as well as a dedicated GNN pipeline trained on ttbar events with pileup 200 in the OpenDataDetector.

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