Beyond 4D Tracking: Cluster Shapes for Track Seeding

Tracking is one of the most time consuming aspects of event reconstruction at the Large Hadron Collider (LHC) and its high-luminosity upgrade (HL-LHC). Innovative detector technologies extend tracking to four-dimensions by including timing in the pattern recognition and parameter estimation. However, existing and future hardware already has additional information that is largely unused by existing track seeding algorithms. The shape (and to a lesser extent, the intensity pattern) of hit clusters provides an additional dimension for track seeding that can significantly reduce the combinatorial challenge of track finding. We use neural networks to show that hit patterns from one-, two-, and three-hit clusters can reduce the rate of fake seeds while preserving a high efficiency for identifying seeds from true particles. Numerical results are presented with simulations from the TrackML challenge and benchmarked against neural network and traditional algorithms.

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