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BESIII track reconstruction algorithm based on machine learning

Track reconstruction is one of the most important and challenging tasks in the offline data processing of collider experiments. For the BESIII detector working in the tau-charm energy region, plenty of efforts were made previously to improve the tracking performance with traditional methods, such as template matching and Hough transform etc. However, for difficult tracking tasks, such as the tracking of low momentum tracks, tracks from secondary vertices and tracks with high noise level, there is still large room for improvement.
In this contribution, we demonstrate a novel tracking algorithm based on machine learning method. In this method, a hit pattern map representing the connectivity between drift cells is established using an enormous MC sample, based on which we design an optimal method of graph construction, then an edge-classifying Graph Neural Network is trained to distinguish the hit-on-track from noise hits. Finally, a clustering method based on DBSCAN is developed to cluster hits from multiple tracks. Track fitting algorithm based on GENFIT is also studied to obtain the track parameters, where deterministic annealing filter are implemented to deal with ambiguities and potential noises.
The preliminary results on BESIII MC sample presents promising performance, showing potential to apply this method to other trackers based on drift chamber as well, such as the CEPC and STCF detectors under pre-study.

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Track Classification: Machine Learning