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BESIII track reconstruction algorithm based on machine learning

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Track reconstruction (or tracking) plays an essential role 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 pattern recognition and Hough transform etc. However, for challenging 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 drift chamber based trackers as well, such as the CEPC and STCF detectors under pre-study.

Keywords: machine learning, tracking, drift chamber, GNN

Reference:
1. Steven Farrell et al, Novel deep learning methods for track reconstruction. arxiv: 1810.06111
2. A Generic Track-Fitting Toolkit. https://github.com/GenFit/GenFit

Significance

This contribution covers novel tracking method based on machine learning dealing with drift chamber based trackers. The results present promising performance.

References

https://indico.cern.ch/event/1128328/contributions/4900740/

Experiment context, if any

BESIII experiment: http://bes3.ihep.ac.cn/

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Session Classification: Poster session with coffee break

Track Classification: Track 2: Data Analysis - Algorithms and Tools