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Auto-tuning capabilities of the ACTS track reconstruction suite

Wednesday, October 26, 2022 11:00 AM (30 minutes)

The reconstruction of particle trajectories is a key challenge of particle physics experiments as it directly impacts particle reconstruction and physics performances. To reconstruct these trajectories, different reconstruction algorithms are used sequentially. Each of these algorithms use many configuration parameters that need to be fine-tuned to properly account for the detector/experimental setup, the available CPU budget and the desired physics performance. Examples for such parameters are cut values limiting the search space of the algorithm, approximations accounting for complex phenomenons or parameters controlling algorithm performance. Until now, these parameters had to be optimised by human experts which is inefficient and raises issues for the long term maintainability of such algorithms. Previous experiences with using machine learning for particle reconstruction (such as the TrackML challenge) have shown that they can be easily adapted to different experiments by learning directly from the data. We propose to bring the same approach to the classic track reconstruction algorithms by connecting them to an agent driven optimiser which will allow us to find the best set of input parameters using an iterative tuning approach. We have so far demonstrated this method on different track reconstruction algorithms within A Common Tracking Software (ACTS) framework using the Open Data Detector (ODD). These algorithms include the trajectory seed reconstruction and selection, the particle vertex reconstruction and the generation of simplified material map used for trajectory reconstruction. Finally, we present a development plan for a flexible integration of tunable parameters within the ACTS framework to bring this approach to all aspects of trajectory reconstruction.

Significance

One of the main lesson from the TrackML challenge and recent machine learning research have shown that using large numbers of tuneable parameters is ideal to create tracking algorithms adapted to different experiments. We present the application of this approach to different tracking algorithms and a plan to generalise it in the ACTS track reconstruction suite.

References

Auto-tuning with Acts was previously presented in CTD : https://indico.cern.ch/event/1103637/contributions/4821875/

Experiment context, if any

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