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Improving Computational Performance of a GNN Track Reconstruction Pipeline for ATLAS

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Track reconstruction is an essential element of modern and future collider experiments, including within the ATLAS detector. The HL-LHC upgrade of the ATLAS detector brings an unprecedented tracking challenge, both in terms of number of silicon hit cluster readouts, and throughput required for both high level trigger and offline track reconstruction. Traditional track reconstruction techniques often contain steps that scale combinatorically, which could be ameliorated with deep learning approaches. The GNN4ITk project has been shown to apply geometric deep learning algorithms for tracking to a similar level of physics performance with traditional techniques, while scaling sub-quadratically. In this contribution, we provide comparisons of physics and computational performance across a variety of model configurations, as well as optimizations that reduce computational cost without significantly affecting physics performance. These include the use of structured pruning, knowledge distillation, simplified and customized convolutional kernels, regional tracking approaches, and GPU-optimized graph segmentation techniques.

Significance

This represents the first set of computational performance results for the novel GNN-based tracking pipeline for the upgraded ATLAS ITk subdetector. This proves that the approach is realistic for both physics requirements and compute budgets.

References

https://cds.cern.ch/record/2882507/files/ATL-SOFT-PROC-2023-047.pdf
https://arxiv.org/abs/2103.06995
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Experiment context, if any

ATLAS

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