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Graph Neural Network-Based Track Finding in the LHCb Vertex Detector

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The next decade will see an order of magnitude increase in data collected by high-energy physics experiments, driven by the High-Luminosity LHC (HL-LHC). The reconstruction of charged particle trajectories (tracks) has always been a critical part of offline data processing pipelines. The complexity of HL-LHC data will however increasingly mandate track finding in all stages of an experiment's real-time processing.
This paper presents a GNN-based track-finding pipeline tailored for the Run 3 LHCb
experiment's vertex detector and benchmarks its physics performance and computational cost against existing classical
algorithms on GPU architectures. A novelty of our work compared to existing GNN tracking pipelines is batched execution,
in which the GPU evaluates the pipeline on hundreds of events in parallel. We evaluate the impact of neural-network
quantisation on physics and computational performance, and comment on the outlook for GNN tracking algorithms for
other parts of the LHCb track-finding pipeline.

Track

Reconstruction

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