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Improving secondary vertexing for HL-LHC: algorithm research using ACTS and ODD

The High-Luminosity Large Hadron Collider (HL-LHC) era promises unprecedented discovery potential but presents significant computational and algorithmic challenges, particularly due to the extreme pileup environment. Accurate and efficient reconstruction of secondary vertices (SVs) originating from the decay of heavy-flavour hadrons or other long-lived particles is critical for key physics measurements, including Higgs boson properties, searches for new phenomena, and precision flavour physics. The increased track multiplicity and event complexity at the HL-LHC demand novel approaches to vertex finding, including the exploration of machine learning techniques, that can maintain high performance under these harsh conditions.

This contribution explores research and development efforts aimed at improving secondary vertexing algorithms for the HL-LHC environment. Our studies leverage the A Common Tracking Software (ACTS) framework, an experiment-independent toolkit designed for track reconstruction R&D. While ACTS has hitherto primarily served as a testbed for innovative tracking algorithms and event data models, this work represents a significant expansion of its scope, applying its flexible infrastructure to the distinct challenges of secondary vertex reconstruction. We utilize ACTS in conjunction with the Open Data Detector (ODD), a simplified yet realistic detector description suitable for algorithm development, to benchmark and compare different approaches for secondary vertex finding and fitting in simulated HL-LHC collision events.

We will present the current status of our research, focusing on the development and evaluation of advanced secondary vertexing algorithms within the ACTS framework. Performance metrics, such as vertex reconstruction efficiency, resolution, and fake rates, will be discussed for various algorithmic strategies, potentially including comparisons between established techniques and newer approaches incorporating machine learning elements. This research aims to demonstrate the suitability of ACTS as a powerful platform not only for tracking but also for vertexing R&D, providing valuable insights and potentially robust algorithmic solutions adaptable by LHC experiments preparing for the HL-LHC upgrade. The use of the shared ODD ensures that findings are broadly relevant and facilitate inter-experiment comparison and collaboration.

Would you like to be considered for an oral presentation?

Yes

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