Contribution ID: **22** Type: **Contributed talk**

Scalable Multi-Task Learning for Event Reconstruction with Heterogeneous Graph Neural Networks

Friday 23 May 2025 11:10 (20 minutes)

The growing luminosity frontier at the Large Hadron Collider is complicating the reconstruction of heavy-hadron collision events both at data acquisition and offline levels with rising particle multiplicities challenging stringent latency and storage requirements. This talk presents significant architectural advancements in Graph Neural Networks (GNNs) aimed at enhancing event reconstruction in high-energy physics. These advancements are implemented and evaluated within the context of expanding the deep full event interpretation (DFEI) framework [García Pardiñas, J., et al. Comput. Softw. Big Sci. 7 (2023) 1, 12], which targets the hierarchical reconstruction of B-hadron decays within the hadronic collision environment of the LHCb experiment.

Specifically, we introduce a novel end-to-end Heterogeneous Graph Neural Network (HGNN) architecture, which allows for unique representations for several particle collision relations and features integrated edge and node pruning layers. The HGNN is trained using a multi-task paradigm, which not only significantly enhances the B-hadron reconstruction performance but also simultaneously enables primary vertex association and graph pruning tasks within a single, unified model. We will discuss the performance improvements achieved, quantifying both the reconstruction accuracy and the effectiveness of the pruning. Furthermore, we propose a weighted message passing scheme designed to improve the model's inference time scalability with minimal performance loss, a key consideration for deployment in high-throughput environments.

Would you like to be considered for an oral presentation?

Yes

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