



Contribution ID: 374

Type: **Talk**

GPU-Accelerated Point Clouds Library for GNN-based Reconstruction and Beyond

Thursday 24 October 2024 16:33 (18 minutes)

High quality particle reconstruction is crucial to data acquisition at large CERN experiments. While the classical algorithms have been successful so far, in recent years, the use of pattern recognition has become more and more necessary due to increasing complexity of the modern detectors. Graph Neural Network based approaches have been recently proposed to tackle challenges such as non-uniformity and high level of sparsity. They have been shown to work well not only for calorimetric reconstruction [1] but also for tracking [2]. These GNN based approaches require fast GPU execution of certain operations (such as kNN computation). We present a fast GPU-enabled software library which significantly outperforms existing approaches including those present in large machine learning frameworks (such as TensorFlow and PyTorch). In light of these optimizations, we discuss the performance and computational requirements of GNN based reconstruction algorithms. Finally, we also discuss how the application of these techniques can be extended beyond particle physics.

[1] Qasim, Shah Rukh, et al. "End-to-end multi-particle reconstruction in high occupancy imaging calorimeters with graph neural networks." *The European Physical Journal C* 82.8 (2022): 1-15.

[2] <https://indico.jlab.org/event/459/contributions/11761/>

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Session Classification: Parallel (Track 3)

Track Classification: Track 3 - Offline Computing