Contribution ID: **410** Type: **Poster**

Real-time muon identification in CMS L1 Trigger using FPGA-based graph neural networks

The Overlap Muon Track Finder (OMTF) is a key subsystem of the CMS L1 Trigger, identifying muon tracks in the transition region between the barrel and the endcap. For the Phase-2 upgrade, we are exploring new approaches and leveraging machine learning (ML) to enhance its performance. In this project, we focus on integrating a Graph Neural Network (GNN) to improve the OMTF's ability to accurately determine the transverse momentum and position of muons. Starting with an existing GNN model built with PyTorch, we carefully design and fine-tune each layer to ensure it runs efficiently on hardware. By converting the GNN from its original high-level framework to High-Level Synthesis (HLS), we can deploy it on specialized FPGA architectures, specifically using Xilinx UltraScale+ FPGAs housed in ATCA boards. Additionally, there is a proposal of implementing the same design on the AI cores of a Xilinx Versal ACAP device, aiming to compare the performances of both implementations. This adaptation transforms the model's graph-based calculations into parallel hardware processes, meeting the real-time processing needs of the trigger system. Future tests are planned to demonstrate that the HLS-converted GNN can maintain the original model's accuracy while providing the necessary speed and performance required for the CMS detector's operations, as well as exploring the AI capabilities of the Versal device.

Secondary track

T11 - Detectors

Authors: CARDINI, Andrea (Deutsches Elektronen-Synchrotron DESY); LEGUINA, Pelayo (University of Oviedo); FOLGUERAS, Santiago (Universidad de Oviedo)

Presenter: LEGUINA, Pelayo (University of Oviedo)

Session Classification: Poster T16

Track Classification: T16 - AI for HEP (special topic 2025)