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Graph Neural Networks for Charged Particle Tracking on FPGAs

Tuesday 31 May 2022 17:00 (25 minutes)

The determination of charged particle trajectories in collisions at the CERN Large Hadron Collider (LHC) is an important but challenging problem, especially in the high interaction density conditions expected during the future high-luminosity phase of the LHC (HL-LHC). Graph neural networks (GNNs) are a type of geometric deep learning algorithm that has successfully been applied to this task by embedding tracker data as a graph—nodes represent hits, while edges represent possible track segments—and classifying the edges as true or fake track segments. However, their study in hardware- or software-based trigger applications has been limited due to their large computational cost. In this talk, we introduce an automated translation workflow, integrated into a broader tool called hls4ml, for converting GNNs into firmware for field-programmable gate arrays (FPGAs). We use this translation tool to implement GNNs for charged particle tracking, trained using the TrackML challenge dataset, on FPGAs with designs targeting different graph sizes, task complexites, and latency/throughput requirements. This work could enable the inclusion of charged particle tracking GNNs at the trigger level for HL-LHC experiments.

Consider for young scientist forum (Student or postdoc speaker)

Yes

Authors: ELABD, Abdelrahman (IRIS-HEP); DUARTE, Javier Mauricio (Univ. of California San Diego (US)); LAI, Bo-Cheng; DEZOORT, Gage (Princeton University (US)); OJALVO, Isobel (Princeton University (US)); NEUBAUER, Mark (Univ. Illinois at Urbana Champaign (US)); ATKINSON, Markus Julian (Univ. Illinois at Urbana Champaign (US)); TRAHMS, Matthew (UW ACME Lab); ELMER, Peter (Princeton University (US)); THAIS, Savannah Jennifer (Princeton University (US)); HAUCK, Scott; HUANG, Shi-Yu; HSU, Shih-Chieh (University of Washington Seattle (US)); RAZAVIMALEKI, Vesal (Univ. Illinois at Urbana-Champaign (US)); 胡, 晉瑄

Presenter: ELABD, Abdelrahman (IRIS-HEP)

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