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Charged particle tracking via edge-classifying interaction networks

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Recent work has demonstrated that geometric deep learning methods such as graph neural networks (GNNs) are well-suited to address a variety of recon- struction problems in HEP. In particular, tracker events are naturally repre- sented as graphs by identifying hits as nodes and track segments as edges; given a set of hypothesized edges, edge-classifying GNNs predict which rep- resent real track segments. In this work, we adapt the physics-motivated Inter- action Network (IN) GNN to the problem of charged-particle tracking in the high-pileup conditions expected at the HL-LHC. We demonstrate the IN's ex- cellent edge-classification accuracy and tracking efficiency through a suite of measurements at each stage of GNN-based tracking: graph construction, edge- classification, and track building. Notably, the proposed IN architecture is sub- stantially smaller than previously studied GNN tracking architectures; this type of reduction in size critical for enabling GNN-based tracking in constrained computing environments. Furthermore, the IN is easily expressed as a set of matrix operations, making it a promising candidate for acceleration via hetero- geneous computing resources.

Primary authors: THAIS, Savannah Jennifer (Princeton University (US)); DEZOORT, Gage (Princeton University (US)); OJALVO, Isobel (Princeton University (US)); ELMER, Peter (Princeton University (US)); ATKINSON, Markus Julian (Univ. Illinois at Urbana Champaign (US)); NEUBAUER, Mark (Univ. Illinois at Urbana Champaign (US)); DUARTE, Javier Mauricio (Univ. of California San Diego (US)); RAZAVIMALEKI, Vesal (Univ. of California San Diego (US))

Presenter: DEZOORT, Gage (Princeton University (US))

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