Contribution ID: **46** Type: **Plenary**

Graph Neural Networks for Track Finding

Tuesday 21 April 2020 19:30 (25 minutes)

To address the unprecedented scale of HL-LHC data, the Exa.TrkX (previously HEP.TrkX) project has been investigating a variety of machine learning approaches to particle track reconstruction. The most promising of these solutions, graph neural networks (GNN), process the event as a graph that connects track measurements (detector hits corresponding to nodes) with candidate line segments between the hits (corresponding to edges). Detector information can be associated with nodes and edges, enabling a GNN to propagate the embedded parameters around the graph and predict node-, edge- and graph-level observables.

Previously, message-passing GNNs have shown success in predicting doublet likelihood, and we here report updates on the state-of-the-art architectures for this task. In addition, the Exa.TrkX project has investigated innovations in both graph construction, and embedded representations, in an effort to achieve fully learned end-to-end track finding.

Hence, we present a suite of extensions to the original model, with encouraging results for both graph construction, classification and track parameter regression. We explore increased performance from trainable graph construction, and the inclusion of detector-level data. These feed into a high-accuracy N-plet classifier, a track parameter regression GNN, or can be used as an end-to-end track classifier by clustering in an embedded space. A set of post-processing methods improve performance with knowledge of the detector physics. Finally, we present a platform for efficient exploration of the plethora of GNN architectures, many of which were applied to this problem.

Consider for young scientist forum (Student or postdoc speaker)

Yes

Second most appropriate track (if necessary)

Architectures and techniques for real-time tracking and fast track reconstruction

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Session Classification: Recording sessions