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Accelerating graph-based tracking with symbolic regression

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In high-energy physics experiments, tracking, the reconstruction of particle trajectories from hits in the inner detector, is a computationally intensive task due to the large combinatorics of detector signals. Recent efforts have proven that ML techniques can be successfully applied to the tracking problem, extending and improving the conventional methods based on feature engineering. However, the inference of complex networks can be too slow to be used in the trigger system. Quantising the network and deploying it on an FPGA is feasible but challenging and highly non-trivial. An efficient alternative can employ symbolic regression (SR), which already proved its performance in replacing a dense neural network for jet classification. We propose a novel approach that uses SR to replace a graph-based neural network. Using a simplified toy-example, we substitute each network block with a symbolic function, preserving the graph structure of the data and enabling message passing. This approach significantly speeds up inference on a CPU without sacrificing much accuracy.

Brainstorming idea [title]

Simple methods for fast inferences of ML models

Brainstorming idea [abstract]

The trigger systems within LHC experiments must work at incredible speeds to decide whether to record or discard a collision event. Due to the need for fast inference, the selection criteria rely on simplified measures rather than fully fledged ones. Consequently, the concern of overlooking interesting events holding potential for new physics discoveries is always present. While ML methods could enhance the identification of such events, their slow inference speed makes them unsuitable for the trigger system's requirements. The question arises: Can we prove that ML models can be accelerated (by using symbolic regression) without losing complexity, generalization and thus physics performance?

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