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Machine Learning for Top Quark Pair Kinematic Reconstruction

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Studies of the top quark provide unique insights into the Standard Model due to its large mass. However, the kinematics of $t\bar{t}$ decays is difficult to reconstruct due to the complexity of these events and limited detector resolution. Neural networks are thought to perform as well as state-of-the-art statistical algorithms for reconstruction purposes.

Our group has developed a machine learning package called AngryTops, a BLSTM neural network that reconstructs $t\bar{t}$ decay pair kinematics resulting from 13 TeV pp collisions. Although the package successfully reconstructs the kinematic variable distributions, we lack a systematic way to evaluate the network's performance on individual events. We implement improvements to better characterise the network's performance. We also introduce an algorithm that matches the observed and truth four-momenta. The variables used for matching are then used to filter the training dataset, retaining only events that the network should be able to reconstruct well.

We train the network on the filtered dataset and evaluate how the network performs compared to the original. Further developments including data augmentation and fine-tuning parameters will be investigated using the matching algorithm as a performance metric.

Primary authors: CHAN, Darren (University of Toronto (CA)); WANG, Maggie (University of Toronto); SINERVO, Pekka (University of Toronto (CA))

Presenter: WANG, Maggie (University of Toronto)

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