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Identification of new long-lived particle states using deep neural networks

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We present preliminary studies of a deep neural network (DNN) "tagger" that is trained to identify the presence of displaced jets arising from the decays of new long-lived particle (LLP) states in data recorded by the CMS detector at the CERN LHC. Particle-level candidates, as well as secondary vertex information, are refined through the use of convolutional neural networks (CNNs) before being combined with high-level engineered variables via a dense neural network. The LLP lifetime is a parameter of the neural network model, which allows for hypothesis testing over several orders of magnitude in lifetime, from ctau = 1 um to 10 m. The network training is performed by streaming ROOT trees containing O(100M) jets directly into the Tensor-Flow queue and threading system. This custom workflow allows a flexible selection of input features and the asynchronous preprocessing of data, such as the resampling and shuffling of batches on the CPU, in parallel to training on the GPU. Domain adaptation is performed with CMS control region data to ensure that MC simulation can be used to accurately model candidate signal events in data. The technical implementation, architecture, workflows, and potential applications are described. We will demonstrate the tagger performance as evaluated with both MC simulation and control region data. Preliminary studies also demonstrate the potential for a universal, model-independent performance for a broad range of signal model hypotheses, such as long-lived resonances.

Consider for promotion

Yes

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