

Machine Learning based global particle identification algorithms at the LHCb experiment

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One of the most important aspects of data processing at LHC experiments is the particle identification (PID) algorithm. In LHCb, several different sub-detector systems provide PID information: the Ring Imaging Cherenkov detectors, the hadronic and electromagnetic calorimeters, and the muon chambers. The charged PID based on the sub-detectors response is considered as a machine learning problem solved in different modes: one-vs-rest, one-vs-one and multi-classification, which affect the models training and prediction. To improve charged particle identification for pions, kaons, protons, muons and electrons, several neural networks and gradient boosting models have been tested. These approaches provide larger area under the curve of receiver operator characteristics than existing implementations in most cases. To reduce the systematic uncertainty arising from the use of PID efficiencies in certain physics measurements, it is also beneficial to achieve a flat dependency between efficiencies and spectator variables such as particle momentum. For this purpose, “flat” algorithms based on the boosted decision trees that guarantee the flatness property for efficiencies have also been developed. This talk presents approaches based on the state-of-the-art machine learning techniques and its performance evaluated on Run 2 data and simulation samples. A discussion of the performances is also presented.

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