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Usage of weakly correlated observables for nuisance parameter fits

Precision measurements at the Large Hadron Collider (LHC), such as the measurement of the top quark mass, are essential for advancing our understanding of fundamental particle physics. Profile likelihood fits have become the standard method to extract physical quantities and parameters from the measurements. These fits incorporate nuisance parameters to include systematic uncertainties. The results depend critically on the selection of observables. Including multiple observables from the measurements is beneficial for precision, as it helps to restrict the nuisance parameters, leading to more reliable fits. Usually, the used observables are assumed to be independent; however, including more observables can introduce correlations that complicate the analysis, as these correlations violate the assumption of independence. At the current precision of the top quark mass measurement, introducing more observables with minor correlations might already lead to a significant distortion of the results of the profile likelihood fit. This project aims to investigate the threshold of correlation at which the accuracy of likelihood fits begins to degrade. We utilize the realistically correlated reconstructed top and W mass, applying an uncorrelated single event likelihood fit for the analysis. To assess the accuracy of our fits, we calculate the pull for the nuisance parameters alongside the top quark mass distribution. Subsequently, we will explore machine learning techniques, such as normalizing flows, that take correlations into account instead of avoiding them.

Primary Field of Research

Machine Learning

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