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Search for BSM Higgs bosons using Machine Learning techniques

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Although the discovery of the 125 GeV Higgs boson has confirmed the Higgs mechanism of the Standard Model (SM), many theories beyond the Standard Model (BSM) has been introduced to solve several phenomena not explained by the SM. One example is the Two Higgs Doublet Models (2HDM), the simplest extension of the SM Higgs sector, that predicted the existence of additional Higgs bosons. In this study, we investigate the use of supervised learning of machine learning method which is hypothesized to be more effective than traditional cut-based method, to search for BSM Higgs bosons decaying into bottom-antibottom quark pairs ($H \rightarrow bb$), the dominant Higgs boson decay channel. We train machine learning models to classify whether events detected by the detector belongs to $H \rightarrow bb$ process (signal) or multijet process (background) based on simulated proton-proton collisions within the Compact Muon Solenoid (CMS) detector. The evaluation matrix is calculated to compare the classification efficiency of models using Neural Networks (NN) and Tree based models. The results show that machine learning models can classify signal and background processes with significant improvement and can be used as signal-background discriminator for further statistical analyses searching for BSM Higgs bosons.

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