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Machine learning with augmentation for boosting di-Higgs searches

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Augmentation of invisible information with respect to many hypothetical models of background and signal processes, can highly improve the performance of the machine learning classifiers for HEP event discrimination. In this regard di-Higgs searches in the channels with multiple invisible final states, is one of the most important applications. Focusing on the di-Higgs channels with 2 bottom quarks + 0/1/2 leptons/taus + MET from bbWW and bbtautau productions, we introduce various augmentation schemes and ways to build better multi-class classifiers using deep neural networks. We conclude our study with demonstration how much the new deep learning classifiers supervised by physical augmentation, can improve the discovery potential of di-Higgs production at the LHC, and discuss on the implications for future collider study.

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