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Event-Level Anomaly Detection for Multijet BSM Searches with Probabilistic Autoencoders

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Although most of Beyond Standard Model (BSM) searches are targeting specific theory models, there has always been a keen interest in the development of model-independent methods amongst the High Energy Physics(HEP) community. Machine Learning (ML) based anomaly detection stands among the latest up-and-coming avenues for creating model-agnostic BSM searches. The focus of this research is the design of anomalous event taggers based on autoencoder models. Alongside the signal discrimination power, a high priority is placed on both signal-model and background-model independence. To this end, the autoencoder is used in conjunction with a Normalizing Flow model tasked with latent space density estimation. Both event reconstruction error and latent representation likelihood are combined in order to mitigate the bias of the resulting event anomaly score. Overall this method is showing promising anomaly detection performance without loosing much in terms of generalization power. On the multijet LHC Olympics data, it is consistently able to identify BSM signals, even in the challenging scenarios posed by the Black Box datasets, where the signal content is unknown.

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