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Generative Models for Resonant Anomaly Detection

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Machine learning-based anomaly detection techniques offer exciting possibilities to significantly extend the search for new physics at the Large Hadron Collider (LHC) and elsewhere by reducing the model dependence. In this work, we focus on resonant anomaly detection, where generative models can be trained in sideband regions and interpolated into a signal region to provide an estimate of the Standard Model background. This estimate can then be compared with data using a machine learning classifier. This approach has been studied for normalizing flows and we explore the possibility of also using Variational Autoencoders (VAEs). We demonstrate this idea by conducting a di-jet resonance search using the LHC Olympics 2020 challenge dataset. The generative algorithm is trained by conditioning on the dijet invariant mass in the mass side-band, and so it can be evaluated in the signal region using a number of kinematic distributions for new resonance classification. The preliminary results are promising and open a new opportunity to address anomaly detection challenges at the LHC.

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