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Unsupervised tagging of semivisible jets with normalized autoencoders in CMS

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Semivisible jets are a novel signature of dark matter scenarios where the dark sector is confining and couples to the Standard Model via a portal. They consist of jets of visible hadrons intermixed with invisible stable particles that escape detection. In this work, we use normalized autoencoders to tag semivisible jets in proton-proton collisions at the CMS experiment. Unsupervised models are desirable in this context since they can be trained on background only, and are thus robust with respect to the details of the signal. The use of an autoencoder as an anomaly detection algorithm relies on the assumption that the network better reconstructs examples it was trained on than ones from a different probability distribution i.e., anomalies. Using the search for semivisible jets as a benchmark, we demonstrate the tendency of autoencoders to generalize beyond the dataset they are trained on, hindering their performance. We show how normalized autoencoders, specifically designed to suppress this effect, give a sizable boost in performance. We further propose a modified loss function and signal-agnostic condition to reach the optimal performance.

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