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Uncovering Anomalies in Gamma-Ray Bursts: A Deep Learning Analysis of X-Ray Afterglows

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In this study, we analyze Gamma-Ray Burst (GRB) X-ray afterglow light curves from the Swift-XRT GRB catalogue using Autoencoder and Variational Autoencoder models with 1D-convolutional layers. The time series data are compressed into a 3D latent space, from which we reconstruct the original light curves and identify anomalous GRBs based on their reconstruction errors. This approach proves to be effective in detecting a variety of anomalies. We also investigate correlations between latent features and additional catalogue data not used during training, and apply topological techniques to identify isolated clusters in the latent space. These findings demonstrate the potential of unsupervised deep learning for data analysis in astroparticle physics.

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