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Anomaly Detection using Autoencoders on Fundamental LZ Signals

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Searching for anomalous data is especially important in rare event searches like that of the LUX-ZEPLIN (LZ) experiment's hunt for dark matter. While LZ's data processing provides analyzer-friendly features for all data, searching for anomalous data after minimal reconstruction allows one to find anomalies which may not have been captured by reconstructed features and allows us to avoid any reconstruction errors. Autoencoders can be used to probe for anomalous light-detecting PMT waveforms resulting from ionization signals (S2) and have found unresolved S2s resulting from multiple scatter interactions. In addition to comparing results to waveform-shape template-fitting methods, these techniques can be extended by applying them to PMT waveforms from prompt scintillation light (S1) and S2 heatmaps which capture positional information. Results from such methods are discussed and compared to known anomalies.

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