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Denoising Gravitational Waves using Deep Learning with Recurrent Denoising Autoencoders HONGYU SHEN, ZHIZHEN ZHAO, DANIEL GEORGE, ELIU HUERTA, Univ of Illinois - Urbana — Gravitational wave astronomy is one of the most rapidly growing fields of modern astrophysics, with observations being made frequently by the LIGO detectors. Gravitational wave signals are often extremely weak and the data from the detectors, such as LIGO, is contaminated with high levels of non-Gaussian and non-stationary noise, often containing transient disturbances which can obscure real signals. Traditional denoising methods, such as principal component analysis and dictionary learning, are not optimal for dealing with this non-Gaussian noise, especially for low signal-to-noise ratio gravitational wave signals. Furthermore, these methods are computationally expensive on large datasets. To overcome these issues, we introduce SMTDAE, a denoising autoencoder based on sequence-to-sequence bidirectional Long-Short-Term-Memory recurrent neural networks. We demonstrate the advantages of using our unsupervised deep learning approach and show that, after training only using simulated Gaussian noise, SMTDAE achieves superior recovery performance for gravitational wave signals embedded in real non-Gaussian LIGO noise.

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