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A Combined Approach Using Empirical Mode Decomposition and Maximal Information Coefficient for Gravitational Wave Detector's Characterization and Noise Hunting

The sensitivity of gravitational wave detectors, such as those used in the Laser Interferometer Gravitational-Wave Observatory (LIGO), is significantly affected by various noise sources, many of which are nonlinear and non-stationary. To effectively characterize and mitigate these noise artifacts, we propose a novel methodology that combines Empirical Mode Decomposition (EMD) and the Maximal Information Coefficient (MIC). EMD adaptively decomposes complex signals into intrinsic mode functions, allowing for a detailed analysis of transient and frequency-varying noise. MIC, on the other hand, quantifies statistical dependencies between different detector channels, enabling the identification of correlated noise sources. By integrating these techniques, our approach provides a robust framework for noise hunting, improving the accuracy of detector characterization. We demonstrate the effectiveness of this method through applications to LIGO data, showcasing its potential to enhance gravitational wave searches by refining noise identification and mitigation strategies.

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