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Addressing Real-World Noise Challenges in Gravitational Wave Parameter Estimation with Truncated Marginal Neural Ratio Estimation

Gravitational wave parameter estimation plays a crucial role in understanding astrophysical phenomena, yet it is often challenged by real-world noise inherent in the detection process. In this work, we use the simulation-based-inference pipeline PEREGRINE to do robust parameter estimation and tailor it to address the complexities of real noise in gravitational wave data analysis. We aim to effectively distinguish gravitational wave signals from noise artifacts, enabling accurate parameter estimation even in challenging observational conditions. We showcase the performance through rigorous validation studies and real-data applications, demonstrating its effectiveness in extracting astrophysical insights from noisy gravitational wave signals. Our work highlights the importance of developing tailored solutions to mitigate real-world noise challenges in gravitational wave astronomy and paves the way for improved parameter estimation methodologies in future observations.

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