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Hierarchical Subtraction with Neural Density Estimators as a General Solution to Overlapping Gravitational Wave Signals

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Overlapping gravitational wave (GW) signals are expected in the third-generation (3G) GW detectors, leading to one of the major challenges in GW data analysis. Inference of overlapping GW sources is complicated - it has been reported that hierarchical inference with signal subtraction may amplify errors, while joint estimation, though more accurate, is computationally expensive. However, in this work, we show that hierarchical subtraction can achieve accurate results with a sufficient number of iterations, and on the other hand, neural density estimators, being able to generate posterior samples rapidly, make it possible to perform signal subtraction and inference repeatedly. We further develop likelihood-based resampling to accelerate the convergence of the iterative subtraction. Our method provides fast and accurate inference for overlapping GW signals and is highly adaptable to various source types and time separations, offering a potential general solution for overlapping GW signal analysis.

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