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Uncertainty Quantification in Gravitational-Wave Burst Waveform Reconstruction with coherent WaveBurst 2G

Minimally modelled searches play a critical role in the detection of short-duration gravitational-wave transients whose morphologies are poorly constrained by existing waveform models. Among these approaches, the Coherent WaveBurst (cWB) algorithm has proven to be a robust and versatile tool for burst searches, enabling the coherent detection and reconstruction of gravitational-wave signals directly from the detector data. However, the limited use of prior information inherent to minimally modelled analyses poses significant challenges for the quality and reliability of waveform reconstruction.

In this contribution, we discuss recent and prospective improvements to the waveform reconstruction process within the cWB framework and address a longstanding open problem in burst analyses: the quantitative assessment of uncertainties associated with reconstructed waveforms. At present, robust confidence intervals or confidence belts for reconstructed burst signals are not routinely available, limiting the interpretability of reconstruction results for astrophysical inference and follow-up studies.

We explore the use of bootstrap-based techniques as a viable and flexible approach to uncertainty quantification in minimally modelled waveform reconstruction. Both parametric and non-parametric bootstrap methods are investigated, with the goal of constructing confidence belts around reconstructed waveforms that capture statistical variability induced by detector noise. We discuss practical implementation strategies, and present results demonstrating their potential to provide meaningful uncertainty estimates. This work represents a step toward more statistically robust waveform reconstruction in gravitational-wave burst searches.

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