

Generating template banks for searches of precessing Binary Black Holes

Tuesday, 24 October 2023 09:45 (15 minutes)

We introduce a novel method to generate a bank of gravitational-waveform templates of binary Black Hole (BBH) coalescences for matched-filter searches in LIGO, Virgo and Kagra data.

Unlike the standard approach, our method relies on a numerical metric approximation of the match between templates, for which we derive an expression suitable to precessing waveforms. We use the determinant of the metric to define a probability measure at any point of the parameter space and, to make the sampling and density evaluation feasible, we train a normalizing flow model targeting the probability distribution on the parameter space. Based on the samples of the normalizing flow model, we devise several strategies to place the templates for a new template bank.

Our method applies to a variety of different manifolds of signals and is particularly suitable for covering high-dimensional spaces, such as those associated with precessing and/or eccentric waveforms.

To demonstrate the capabilities of our code, we generate a bank for precessing black holes and show that it covers the space in a satisfactory way. Our publicly released code `mbank` will enable searches of high-dimensional regions of BBH signal space, hitherto unfeasible due to the prohibitive cost of bank generation.

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Session Classification: Data Analysis

Track Classification: Data Analysis