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Gaussian processes for managing model uncertainty in gravitational wave analyses

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Successfully and accurately inferring the properties of compact binary mergers observed by facilities including Virgo and LIGO requires accurate and fast waveform models. Direct calculation from general relativity is not currently feasible, and approximations that are used to produce tractable models necessarily induce errors.

Using Gaussian process regression (GPR), we have developed a technique to quantify the systematic errors in an approximate waveform model. We have incorporated our model into a parameter estimation pipeline, which allows the waveform's uncertainty to be included in the posterior probability distribution over the astrophysical properties inferred for a GW signal's source.

We present early results of parameter estimation using different GPR-backed waveform models which incorporate waveform uncertainty. These techniques will be vital to performing accurate parameter estimation in the high signal-to-noise regimes anticipated in third generation detectors such as the Einstein Telescope.

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