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Accelerating parameter estimation of Galactic binaries in the full LISA frequency band using Gaussian Process Regression

mercredi 23 novembre 2022 16:00 (15 minutes)

We present an end-to-end pipeline using Gaussian Process Regression to model the log-likelihood function for parameters of Galactic binaries. It is expected that tens of millions of Galactic binaries will be the dominant sources of observed gravitational waves, emitting quasi monochromatic gravitational waves, which will be constantly measured by LISA. To resolve as many Galactic binaries as possible is a central challenge of the upcoming LISA data set analysis. It is estimated that tens of thousands of these overlapping gravitational wave signals are resolvable, and the rest blurs into a galactic foreground noise. Extracting these tens of thousands of signals using Bayesian approaches is computationally expensive. We developed and tested a novel pipeline using Gaussian Process Regression in order to rapidly compute Bayesian posterior distributions. The Gaussian Process Regression offers a significant speed-up over the full evaluation of the likelihood function, e.g. using Metropolis Hastings methods. Using the pipeline we are able to solve the Lisa Data Challenge (LDC) 1-3 consisting of noisy data as well as further challenges with overlapping signals in the full LISA frequency band as being the focus of LDC 1-4 containing millions of overlapping signals.

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