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GPry - Fast Bayesian inference with Gaussian Processes

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LISA will offer a window into many different, simultaneously observed sources in a long, narrow band signal. Inferring source parameters will - for complex waveforms - require computationally expensive simulations, especially if those waveforms are generated in time domain.
This in turn makes Bayesian inference using such codes extremely expensive: typical sampling algorithms like Markov chain Monte Carlo or nested sampling usually take many tens of thousands of evaluations of the likelihood/posterior distribution. Hence it requires many signal-generations and subsequent comparisons to data. Likelihood-free approaches circumventing this problem have lately gained some attention. However, these come with their own set of challenges such as managing biases and often require methods tailored to the problem at hand. With our Python package "GPry"we introduce a new tool keeping the simplicity and robustness of likelihood-based inference, while drastically reducing the number of samples required for getting an MC sample of the posterior. This approach is based on interpolating the posterior distribution with a suitable Gaussian process and a deterministic, sequential acquisition of likelihood samples inspired by Bayesian optimization. We show the performance of the algorithm on test distributions and how this algorithm could be applied to sources in the LISA band.

Auteur principal: EL GAMMAL, Jonas (University of Stavanger)

Co-auteurs: NARDINI, Germano (University of Stavanger); TORRADO, Jesus; Dr BUSCICCHIO, Riccardo (Universitá di Milano-Bicocca)

Orateur: EL GAMMAL, Jonas (University of Stavanger)

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