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Gravitational-wave posterior post-processing with normalizing flows

Bayesian inference is essential for understanding the compact binaries that produce gravitational waves detected by the LIGO-Virgo-KAGRA collaboration. Performing this inference is computationally expensive and often has to be repeated multiple times with different models, e.g. different approximations of General Relativity. These repeated analyses always start from scratch, which is highly inefficient. This process could be improved by leveraging the similarities between analyses to significantly reduce the computational cost.

In this work, we propose a novel machine-learning-based method to address this inefficiency. We use normalizing flows to post-process the posterior distribution from an initial analysis to reflect a new likelihood function. This approach produces a posterior distribution and evidence estimate that are consistent with a full reanalysis but at significantly reduced computational cost. We demonstrate the effectiveness of this method in various scenarios, including updating sky maps with galaxy catalogue information and reanalysing data with alternative waveform models.

AI keywords

normalizing flows, Bayesian inference, neural networks

Primary author: Dr WILLIAMS, Michael (University of Portsmouth)

Co-author: Dr LEYDE, Konstantin (University of Portsmouth)

Presenter: Dr WILLIAMS, Michael (University of Portsmouth)

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