

A neural likelihood estimator for fast evidence computation

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The discovery of gravitational waves (GWs) has opened a new window to observe our universe which is inaccessible with other probes. Since 2015, almost 100 GW signals have been observed, allowing us to probe the nature of gravity, study the expansion of the universe as well as probe the equation-of-state of dense nuclear matter. Within the next decade, GW detectors are envisaged to undergo upgrades leading to extremely precise measurements of fundamental properties of our universe, as well as enabling us to see the dark ages before formation of compact objects. The observed GW signals will be much longer and louder due to the improved sensitivities and the computational costs of GW inference is expected to rise exponentially.

As both the complexity and the volume of data itself rise, we need to develop robust and efficient alternatives to current parameter estimation methods to produce accurate scientific outputs without prohibitive resource usage.

In this work, we present a novel way of dramatically reducing the computational costs of stochastic algorithms by approximating the analytical Bayesian likelihood with a Neural likelihood estimator. This method obtains compatible posteriors and returns the correct Bayesian evidence, requiring only a fraction of waveforms computations compared to standard methods.

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