Research Result Report
ICRR Inter-University Research Program 2025

Research Subject:

Development of PSO method for Parameter estimation

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Summary of Research Result :

Accurate gravitational-wave parameter estimation requires a noise power spectral density (PSD) that describes the detector state at the time of the event. Standard transient analyses often assume that the strain noise is stationary and Gaussian over the data used to estimate the PSD, although real interferometer strain commonly contains slow nonstationarity, spectral lines, glitches, and heavy tailed residuals. This project formulates and develops a local PSD-fitting strategy in which the PSD model is inferred from one immediately pre-event strain segment with the same duration as the segment used for event analysis. The equal-duration choice keeps the Fourier resolution and windowing contract matched to the event likelihood while reducing reliance on long off-source stationarity. We describe the adopted positive PSD model, including amplitude-domain power laws, damped Lorentzian narrow-band features, and shapelet corrections; the Whittle, Welchgamma, robust log-spectral, and whitened-strain diagnostic objectives; and the particle-swarm model-selection method used to fit one noisy periodogram. Controlled mock-data viability tests show that the workflow returns finite positive PSDs, improves over flat baselines, and recovers known synthetic spectra within bounded log error. The result is a science-facing framework for local detector-noise modeling; it is not a claim that a single fitted PSD removes all non-Gaussian or nonstationary effects, which must be checked by ratio and whitened-strain diagnostics. We have found that the most reasonable fitting model is asd-max model, which select the maximum value for each frequency bins.

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