**Erratum: Efficiency of the cross-correlation statistic for gravitational
wave stochastic background signals with non-Gaussian
noise and heterogeneous detector sensitivities**
[Phys. Rev. D **92**, 104025 (2015)]

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(Received 17 January 2018; published 20 February 2018)

We present an erratum with respect to the paper. The results presented are based on an incorrect expression for the standard detection statistic, which does not include the correction to the cross-correlation term that is required when the detector sensitivities are assumed to be known. We are grateful to Joe Romano for pointing out the problem and providing helpful feedback in the revision efforts.

DOI: [10.1103/PhysRevD.97.049903](https://doi.org/10.1103/PhysRevD.97.049903)

In this paper, we introduce an alternative detection statistic $DS_{\text{alt}} = \frac{1}{T} \sum_{t=1}^T \mathcal{H}_{1t}^2 \mathcal{H}_{2t}^2$, where $\mathcal{H}_{1t} = \mathcal{S}_t + \mathcal{N}_{1t}$ and $\mathcal{H}_{2t} = \mathcal{S}_t + \mathcal{N}_{2t}$ are the measurement outputs for two colocated and coaligned detectors, and where $\mathcal{S}_t$ denotes the signal, and $\mathcal{N}_{it}$ the noise on detector i . This detection statistic involves quadratic functions of the signal $\mathcal{S}_t^2$ but also quadratic functions of the noise distributions $\mathcal{N}_{1t}^2$ and $\mathcal{N}_{2t}^2$, implying that its variance becomes an explicit function of the fourth-order cumulant of the signal and noise distributions, which is of relevance when these distributions show deviations from the Gaussian assumption.

Implicitly casting the analysis in the situation where detector noise σ_1 and σ_2 are known, we also claim that this alternative statistic dominates the standard cross-correlation statistic for some parameter values not only for non-Gaussian distributions, but also with Gaussian signal and noise distributions when the ratio of the detector sensitivities reaches 1 order of magnitude. If correct, this latter finding would imply a violation of the Neyman-Pearson theorem, which states that the cross-correlation statistic is optimal in the Gaussian case since it can be obtained as a monotonic transformation of the likelihood ratio.

The problem in the analysis presented in the paper is that it is based on an incorrect expression for the optimal detection statistic in the situation where detector noise σ_1 and σ_2 are known. In other words our results show that the alternative detection statistic may dominate a detection statistic that is *not* the optimal one, and as such imply no violation of the Neyman-Pearson theorem since they merely relate to the relative performance of two detection statistics none of which is in fact optimal.

To be specific, when detector sensitivities σ_1 and σ_2 are known or at least are sufficiently well estimated, the optimal detection statistic is *not* the standard correlation statistic $DS_{cc} = \frac{\bar{\alpha}^2}{\sigma_1 \sigma_2} = \frac{\sum_{t=1}^T \mathcal{H}_{1t} \mathcal{H}_{2t}}{\sigma_1 \sigma_2}$, which we have wrongly used as a benchmark in our analysis [see Eq. (10) in the paper, where we do not use the normalization by the product of the volatilities since we are implicitly assuming that they are known],

$$DS_{cc} = \frac{\bar{\alpha}^2}{\sigma_1 \sigma_2} = \frac{\sum_{t=1}^T \mathcal{H}_{1t} \mathcal{H}_{2t}}{\sigma_1 \sigma_2}. \quad (1)$$

The optimal detection statistic is instead [see for example Eq. (3.15) in [1]]

$$DS_{kds} = \bar{\alpha}^2 + \frac{1}{2} \left[\frac{\sigma_2^2}{\sigma_1^2} \bar{\sigma}_1^2 - \sigma_2^2 + \frac{\sigma_1^2}{\sigma_2^2} \bar{\sigma}_2^2 - \sigma_1^2 \right], \quad (2)$$

where $\bar{\sigma}_1^2 = \sum_{t=1}^T \mathcal{H}_{1t}^2$. Because of the presence of the correction term

$$\frac{1}{2} \left[\frac{\sigma_2^2}{\sigma_1^2} \bar{\sigma}_1^2 - \sigma_2^2 + \frac{\sigma_1^2}{\sigma_2^2} \bar{\sigma}_2^2 - \sigma_1^2 \right]$$

in the right-hand side of Eq. (2), we observe that the optimal detection statistic already contains quadratic functions of the signal $\mathcal{S}_t^2$ but also quadratic functions of the noise distributions $\mathcal{N}_{1t}^2$ and $\mathcal{N}_{2t}^2$.

The detection statistic with known detector sensitivities given in Eq. (2) is the optimal likelihood detection statistic in the Gaussian case, but it is not necessarily optimal in the presence of non-Gaussian signal or noise distributions. We are currently working on a revised version of the paper, where we analyze how the presence of deviations from the Gaussian assumption impacts the performance of the standard detection statistic, and also discuss the estimation and detection problems in the presence of nontrivial higher-order cumulants for signal and/or noise distributions.

- [1] S. Drasco and É. É. Flanagan, Detection methods for non-Gaussian gravitational wave stochastic backgrounds, [Phys. Rev. D **67**, 082003 \(2003\)](#).