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Adaptive cancellation of mains power interference in continuous gravitational wave searches with a hidden Markov model

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Continuous gravitational wave searches with terrestrial, long-baseline interferometers are hampered by long-lived, narrowband features in the power spectral density of the detector noise, known as lines. Candidate GW signals which overlap spectrally with known lines are typically vetoed. Here we demonstrate a line subtraction method based on adaptive noise cancellation, using a recursive least squares algorithm, a common approach in electrical engineering applications such as audio and biomedical signal processing. We validate the line subtraction method by combining it with a hidden Markov model, a standard continuous wave search tool, to detect a synthetic continuous wave signal with an unknown and randomly wandering frequency which overlaps with the strong mains power line at 60 Hz in the Laser Interferometer Gravitational Wave Observatory. The performance of the line subtraction method with respect to the characteristics of the 60 Hz line and the control parameters of the recursive least squares algorithm is quantified in terms of receiver operating characteristic curves.

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