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Predicting the motion of a high-Q pendulum subject to seismic perturbations using machine learning

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The seismically excited motion of high-Q pendula in gravitational-wave observatories sets a sensitivity limit to sub-audio gravitational-wave frequencies. Here, we report on the use of machine learning to successfully predict the motion of a high-Q pendulum with a resonance frequency of 1.4 Hz that is driven by natural seismic activity. We achieve a reduction of the displacement power spectral density of 40 dB at the resonant frequency 1.4 Hz and 6 dB at 11 Hz. Our result suggests that machine learning is able to significantly reduce seismically induced test mass motion in gravitational-wave detectors in combination with corrective feed-forward techniques.

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