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Evaluating deep neural networks for Newtonian noise subtraction in GW detectors

Newtonian noise (NN), arising from local density fluctuations due to seismic activities will limit the sensitivity of next-generation gravitational wave detectors at low frequencies. This study explores deep learning models as non-linear algorithms to predict and cancel NN.

As a preliminary experiment prior to obtaining Einstein Telescope data, we utilise data from the Virgo detector, which has an array of 24 seismometers and a tiltmeter acting as a proxy for surface-wave induced NN. We train deep learning models, including Long Short-Term Memory (LSTM) networks, Transformers, and Convolutional Neural Networks (CNN). Their performance is compared against conventional Wiener filtering methods, known to be the optimal linear filter. Our preliminary results demonstrate strong potential for deep learning methods in frequency bands of interest, indicating that these techniques will be beneficial for the Einstein Telescope.

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