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Deep Learning Based Real-Time Noise Mitigation

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Mitigation techniques for Newtonian noise are essential due to the increasing sensitivity of future earth-based gravitational wave detectors. We are exploring deep learning as a model-independent technique to predict seismic-induced variations of the interferometer strain. Compared to conventional Wiener filters, convolutional neural networks can learn to distinguish a multiplicity of patterns and adapt to variations in the signal-to-noise ratio. Evaluating these networks on Field Programmable Gate Arrays (FPGAs) enables real-time prediction with high throughput and stable timing. We present a toolchain for optimizing the architecture of a quantized neural network to utilize the FPGA resources efficiently. In our lab setup, the network has outperformed a Wiener filter in canceling mechanically coupled vibrations in a small interferometer.

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