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Deep learning merger masses estimation from gravitational waves signals in thefrequency domain

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Detection of gravitational waves (GW) from compact binary mergers provide a new window into multi-messenger astrophysics. The standard technique to determine the merger parameters is matched filtering, consisting in comparing the signal to a template bank. This approach can be time consuming and computationally expensive due to the large amount of experimental data which needs to be analyzed.

In the attempt to find more efficient data analysis methods we develop a new frequency domain convolutional neural network (FCNN) to predict the merger masses from the spectrogram of the detector signal, and compare it to time domain neural networks (TCNN). Since FCNNs are trained using spectrograms, the dimension of the input is reduced as compared to TCNNs, implying a substantially lower number of model parameters, and consequently less over-fitting. The additional time required to compute the spectrogram is approximately compensated by the lower execution time of the FCNNs, due to the lower number of parameters.
In our analysis FCNNs show a slightly better performance on validation data and a substantially lower over-fit, as expected due to the lower number of parameters, providing a new promising approach to the analysis of GW detectors data, which could be further improved in the future by using more efficient and faster computations of the spectrogram.

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