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GWEEP: A Deep Learning Toolkit for Gravitational Waves Analysis

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As space exploration continues to expand, machine learning has proven many times to be an important item in our astrophysical data analysis toolbox, very elegantly navigating the challenges of high computational demands and the complexity of multi-dimensional parameter spaces that often occur when trying to process and understand the Universe's messages.
In this study, we have successfully demonstrated the use of machine
learning techniques for enabling multi-messenger astronomy with
gravitational waves. As demonstrated only a few years ago, during the detection of the event GW170817 [1] by LIGO/Virgo, it is of great importance in a gravitational wave experiment to have a rapid mechanism for alerting other observatories about potential events, so that multi-messenger observations could be performed. In this context, we have developed GWEEP toolkit (Gravitational Wave data analysis using DEEp Learning), a neural network based low-latency alert pipeline for a quick and precise gravitational wave event detection and parameter estimation. We have tested our solution on simulated data from the LISA Data Challenge [2], which is part of the LISA [3] consortium. We will present an overall view of the GWEEP pipeline, describing the functionality of each of its components, the methodology, and the results obtained in detecting gravitational waves from LISA-like data.
In the future, we aim to develop a generic toolkit of detecting Massive
Black Hole Binary (MBHB) events that can be easily customized and adapted for future gravitational wave detectors, using various interchangeable deep learning models (ANNs, CNNs, RNNs, etc). We plan to perform incremental training on large labeled datasets and make fast predictions on new data for a set of fine tuned models.

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