Deep learning classification of the continuous gravitational-wave signal candidates from the time-domain F-statistic search

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There are many potential sources of gravitational waves (GW) still awaiting detection. Among them, particular attention is given to the non-axisymmetric neutron star (NS). The emitted, almost monochromatic signal is expected to be detected in the near future by LIGO and Virgo detectors. Although the GW waveform is well known, its small amplitude makes it extremely hard to detect. The accepted approach in searching for continuous GWs is a matched filter technique known as the F-statistic method. The method generates large number of GW candidate signals that have to be further analyzed.

In our work we present the application of deep learning in the analysis of F-statistic signal candidates. To model the continuous GW we use the spinning triaxial NS ellipsoid signal injected in the Gaussian noise. Our dataset contains also stationary lines mimicking local artifacts in the detector frame. In the first part of our research we study the application of convolutional neural networks for the classification of the GW. Second part of the talk is focused on various unsupervised deep learning algorithms in order to clusterize the dataset.

Our research shows the benefits of using deep learning in the context of the classification of continuous GWs. It also gives limits to the signal-to-noise ratio of the signal our method is able to correctly identify.