Commentary
Volume 9:3, 2021

Journal of Astrophysics & Aerospace Technology

ISSN: 2329-6542 Open Access

Detection of Unclassified Noise Transients in LIGO-Virgo Data

Galit Alter*

Department of Space Technology, Debre Tabor University, Debre, Ethiopia

About the Study

Data from current gravitational wave detectors contain a high rate of transient noise (glitch) that can cause false positives and obscure true astrophysical events. Existing noise detection algorithms are primarily model-based and can overlook noise transients that are not recognized by auxiliary sensors nor have exotic forms. We propose a unicorn multi-window anomaly detection pipeline (UniMAP). This is a model-free algorithm for transient noise identification and characterization that Temporal Outlier Factor (TOFs) via a multi-window data resampling scheme. We show that this window scheme extends the anomaly detection capabilities of the TOF algorithm to resolve noise transients of any form and duration. It demonstrates the effectiveness of this pipeline in detecting glitches during the third observation performed by LIGO and Virgo and describes possible applications.

Kilometer-scale interferometers, the Advanced Laser Interferometer Gravitational Wave Observatory (LIGO) and Advanced Virgo, can detect distance changes between mirrors with a proton width of up to 105. As such, these interferometers are one of the most sensitive instruments ever manufactured. To date, they have safely demonstrated over 50 compact binary gravitational waves. However, this unprecedented sensitivity is complex to extract the target astrophysical signal from the noise background and prevent noise transients from being mistakenly identified as astrophysical events. This is a noise filtering issue.

The raw strain data generated by the gravitational wave detector contains permanent and transient noise features. Non-Gaussian noise transients can mask or mimic real transient astrophysical signals. These transient noises, also known as glitches, can be caused by conditions in the equipment or environment. However, many exact sources are unknown. Currently, the standard way to characterize noise transients in LIGO and Virgo data is to first identify them using overpower detection algorithms such as SNAX, and then classify them according to common sources or morphologies. That is, there are various classification approaches in the literature, including algorithms that use information from auxiliary channels to measure the behavior of the detector and its surroundings, B.hveto and iDQ. Complementary approaches classify glitches based on the time-frequency morphology of GW detector data, such as gravity spies and other morphology-based classifiers using images and wavelets.

Conclusion

One of these classification algorithms, iDQ, has been incorporated into the GstLAL search pipeline to help determine candidate significance. iDQ and other tools have been included as part of LIGOVirgo candidate event validation procedures, both in near-real-time in response to public alerts and in higher latency to vet GW events for catalogs. For example, iDQ, hveto, and Gravity Spy were employed in LIGO-Virgo event validation during the most recent observing run. To detect noise transients in interferometer data, we require an anomaly detection algorithm that can pick out subsequences of data in a time series. Therefore, we exclude methods such as distance based outliers and conformal k-nearest-neighbor anomaly detection schemes that focus on detecting individual outlying data points. In particular, it also excludes adjustments for univariate time series temporal outlier factors. In reality, partial sequences of anomalous data often form their own clusters and are barely detectable except at the points that form the rising and falling edges.

How to cite this article: Alter, Galit. "Detection of Unclassified Noise Transients in LIGO-Virgo Data." *J Astrophys Aerospace Technol* 9 (2021) : 181.

***Address for Correspondence:** Galit Alter, Department of Space Technology, Debre Tabor University, Debre, Ethiopia, Tel: +251931883823; E-mail: altergalit@gmail.com*

Received: October 04, 2021; **Accepted**: October 18, 2021; **Published**: October 25, 2021