Environmental Monitoring System - Coupling Function Calculator Progress Report I LIGO-T1600387-v1

Julia Kruk

Abstract— **The first four weeks working under Robert Schofield at LIGO Hanford were spent constructing a python program capable of configuring coupling functions for multiple sensors during a specific injection. The code is currently undergoing its final revisions and debugging procedures. The next steps are improving the user friendliness of the current script and writing another program that would plot multiple coupling functions on the same window for comparison and for presentation purposes.**

I. Background

The calculation of coupling functions is an important step in the gravitational wave vetting process. If part of a trigger falls below 7 or 10 times the expected DARM background, it is flagged and passed down to the environmental monitoring group for further evaluation. By applying calculated coupling functions to see if a DARM signal is comparable to what the function demonstrates environmental noise would look like, the trigger can either be rejected as a result of environmental phenomena. The coupling functions were calculated by hand for the first detection in September. Yet with detections expected to occur with a greater frequency in 2016 than originally anticipated, this process had to be automated.

II. Project Status

The program is designed to consist of two scripts, a configuration file, and a text file containing a complete list of all the channel names used for environmental monitoring. The main script features the sorting process, which analyzes the input and sorts through channel names based on search keys to compile a list of desired channels. The second script contains all the classes, methods and functions that are used to calculate the FFTs, amplitude density spectra, calibrate the spectral data and create the coupling functions. The configuration file allows for easy manipulations of variables that are used throughout the code, such as the DARM and sensor threshold factors used to determine the validity of the calculated coupling factor and the times used for time series data extraction from the interferometer. Currently, the code is equipped with an options parser that allows for greater flexibility of the program. The user can specify the form of data output they desire within the options parser, as well as whether to import the default configuration file or a custom one, import a unique list of channels if need be and enter key words for channel sorting. If no specifications are given, the code is capable of running all 150+ channels, plotting their coupling functions and exporting data in csv form in a new directory in under 10 minutes.

III. Next Steps

As of today, July 6 2016, the code successfully sorts channels, calculates coupling functions, exports data and organizes it in time-stamped directories. The next few days will be spent running channel names with September times and comparing the results with past coupling function of each sensor type. After the calculations in the code are confirmed to be correct, the primary effort will be to significantly improve the program's user friendliness and provide sufficient documentation for future users who may wish to use and build upon the code. Once this is accomplished, another program will be written to calculate and display the coupling factors of multiple channels on one plot. This will be done for comparison and presentation purposes, and to be included in future report and posters. For the sake of accuracy, only real coupling factors will be used to calculate these functions.

References

[1] Schofield, Robert. Lightning, LIGO and GW150914. Tech. Logbooks LHO LLO, 24 Jan. 2016. Web. 5 July 2016. ¡https://alog.ligo-la.caltech.edu/EVNT/index.php?callRep=11564¿.

[2] Binary Black Hole Mergers in the First Advanced LIGO Observing Run. Publication no. P1600088-v16. N.p.: LIGO Scientific Collaboration and Virgo Collaboration, 2016. Print.