## How do we really look for gravitational waves? A tour of some applied mathematical tools used within the LIGO and Virgo collaborations.

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**Abstract.** Direct observations of gravitational waves from merging black hole binaries by the LIGO gravitational-wave observatories are certainly among the most exciting results in physics in the new millennium. Its well known these observations were enabled by incredible engineering feats on multiple systems. However, these observations are equally a product of innovative analysis methods applied to the data output by the observatories.

Here I will give a broad overview of the types and methods of data analysis used towards gravitational wave discovery. This will cover some of the tricks used in optimization, dealing with computational bounds, through to some of the less advertised or obvious obstacles and novelties, such as applying citizen-science and machine learning to guaranteeing data quality.

