Analysis in cross-correlating statistically independent noise channels  
(poster 32, Antonis Mytidis and Bernard Whiting  (LSC – UF) 

\[
SNR(f, t, \hat{\Omega}) = \text{Re} \left| \frac{csd_{XY}(f, t)}{\sqrt{psd_{XX}(f, t) psd_{YY}(f, t)}} \right| Q(f, t, \hat{\Omega})
\]
Multi-baseline signal consistency tests for searching gravitational-wave signals in LIGO and Virgo detectors from compact binary coalescences
Thilina Dayanga, Washington State University, Pullman, WA

- How to improve the performance of the null-stream discriminator in multi-detector compact binary searches?
- Variation in the null-stream statistic values as a function of sky-position
Deep learning pipeline for time series data mining
(more detailed blueprint)

Raw data
  → CV clustering
  → Model M₁
  → Anomaly detection
  → Anomalous clusters (if any)

CV clustering
  → Data Abstraction Level 1 (AL1)
  → NB: Centers of normal clusters in M₁
  → Anomalous clusters (if any)

CV clustering
  → Data Abstraction Level 2 (AL2)
  → Topographic map
  → Category map
  → Layered SOM maps for localization of BMUs

Localization pipeline
  → Model M₂
  → Labeling map

LIGO DCC G-1100020

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TAMING INSTRUMENT GLITCHES AND DETECTING BURST SIGNALS

PAUL T. BAKER, NEIL CORNISH, TYSON LITTENBERG

1. Goal
to distinguish signals from glitches using Bayesian methods

2. Methods
• Markov Chain Monte Carlo (MCMC)
• simulated LIGO Virgo data
  coherent signal
  colored gaussian noise
  non gaussian “glitches”
• wavelet domain analysis
• simultaneously search for signals and glitches

Figure 1: a Reverse Jump histogram showing the number of chain iterations in each non-zero pixel number model.

Figure 2: A glitchy simulated datastream (transformed back to the time domain) in 2 IFOs. The injected GW signal is at ~6s. Other loud spikes are glitches.
Application of a Novel Clustering Technique for Glitches in Gravitational Wave Data

Papia Rizwan
Soma Mukherjee
Center for Gravitational Wave Astronomy
University of Texas at Brownsville

Overview of the technique:

Figure 1.0 showing 70 simulated glitch signals of 5 types mixed with noise of variance 0.25

The signals have to be normalized to mean 0 and variance 1. Two signals having a similar shape but different phase and frequency are placed into the same group.

Figure 2.0 showing the detailed outline of FTSE algorithm computing LCSS between a pair of operations followed by a snapshot of the adjacency matrix of actual data produced as output

Accuracy and Time Complexity:

The clustering technique involves two major steps: 1. Creating adjacency matrix from FTSE and LCSS, and 2. Clustering the matrix data with validity measure and K-means. As noise increases in glitch signals, the signals become less distinct and hence less distinguishable from each other. As a result, fewer number of clusters is detected than what it should have been without the noise. It is important to note which of the two steps in our technique introduces error in finding clusters in noise increases. Generally, to find the source of inaccuracy (out of the two steps), we constructed 11 identical sets of glitch signals and trained each with increasing levels of noise with variances from 0.055 to 0.05 (fig. 1.8 shows one of the sets). In order to test one step, we kept the other unchanged. First we ran FTSE and LCSS on the noisy data we created and clustered it with K = 5 (already found, refer to fig. 3.0) in K-means. From the results shown in fig. 5.0, it can be hoped that the error is not caused by FTSE and LCSS in computing the adjacency matrix. Thus we assumed the source of error rests with step 2. We ran the validity measure 105 times on each set of noisy data (see information in fig. 6.0) step 2 being the source of inaccuracy in noise dominated data.
Overview:

- GW detectors may be affected by short-duration noise transients ("glitches").
- Glitches may mimic many (but not all) aspects of a GW signal in a detector.
- We are developing a likelihood algorithm for evaluating potential GW candidates for consistency with true signal.
- Algorithm is based on three parameters, including coherence between detectors.

Introduction

Glitches may mimic GW signals in a detector. We are developing a likelihood algorithm for evaluating potential GW candidates for consistency with true signal. The algorithm is based on three parameters, including coherence between detectors.

Example: 2 Maps

Next Steps

How do pipelines handle glitches?

References

Poster: in middle room
Goal: Identify times when noise sources are coupling into the detectors.

Reason: We only want to remove times when we know that the detector is being affected by noise sources.

Note: Please see Eric’s talk this afternoon for more information.

Figure: Ft-maps of an airplane and helicopter.
Search for a Stochastic Gravitational Wave Background with Torsion-bar Antennas

A Shoda, K Okada, K Ishidoshiro, M Ando, Y Aso, K Tsubono

Torsion-Bar Antenna (TOBA)

✓ The ground based GW antenna which have a good sensitivity below 1 Hz.

✓ We have two prototypes of TOBA at Tokyo and Kyoto in Japan.

First simultaneous observational run at both site

TARGET: a stochastic GW background

New upper limit is expected around 0.1-1.0 Hz

We have two prototypes of TOBA at Tokyo and Kyoto in Japan.

The estimate of this work

Previous results and TOBA’s result