LIGO-G990079-38-M

Non-parametric method for detecting non-stationarity

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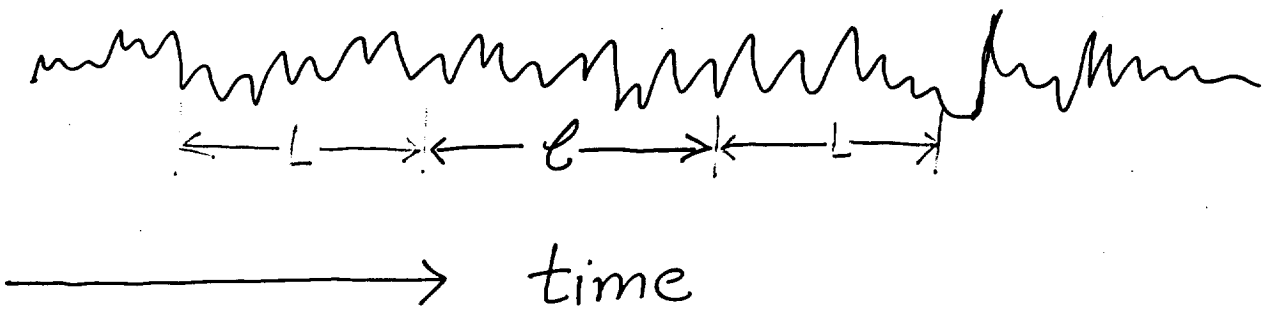
PLAN OF THE TALK

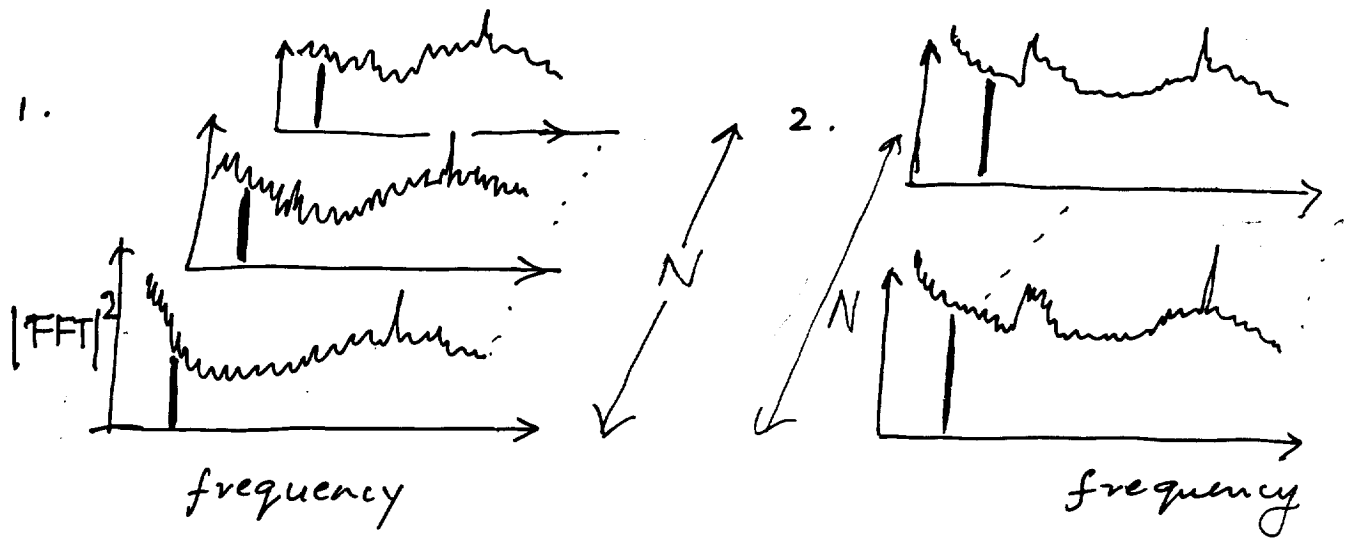
- Description of the test
- Non-parametric tests & their importance.
- Examples / Results
  (Simulated & 40m data)

A schematic of the test



1.

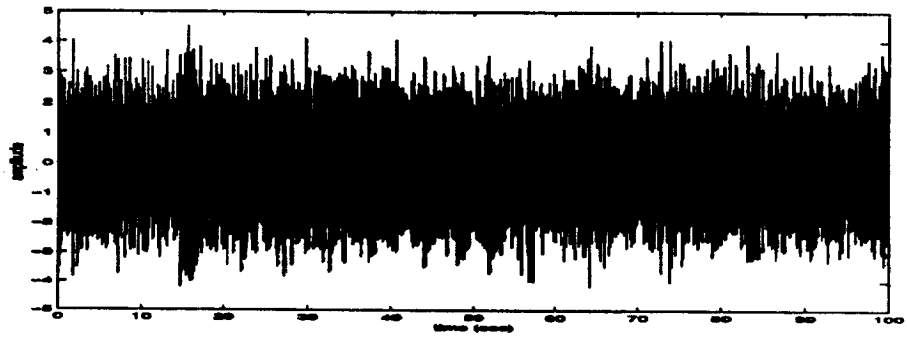
2.



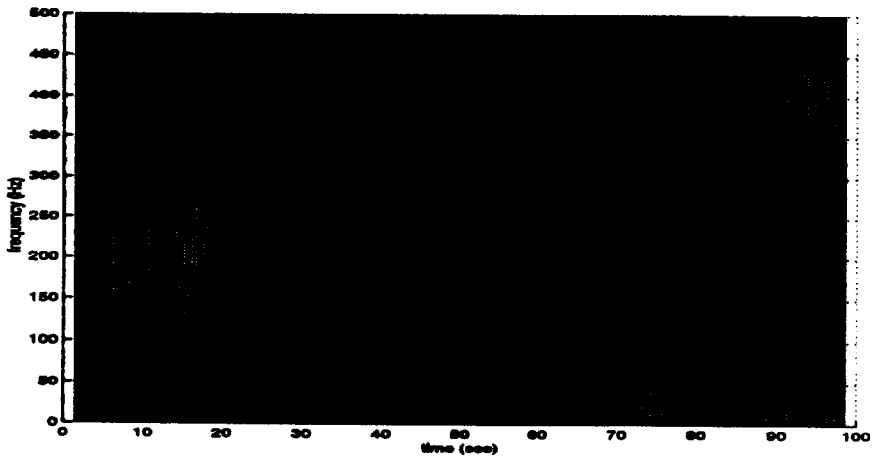
$$t = \frac{|\hat{\mu}_1 - \hat{\mu}_2| \sqrt{N}}{\sqrt{\hat{\sigma}_1^2 + \hat{\sigma}_2^2}}$$

The test in action

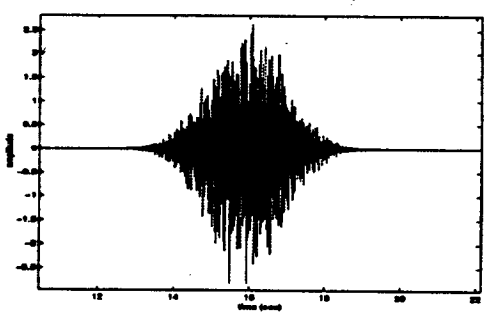
Simulated data

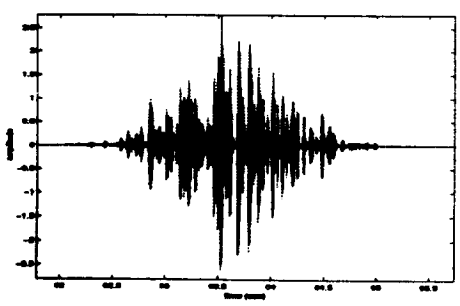


Output of the test



Injected bursts





Non-parametric tests

Example: χ^2 test !

significance level computed independently of any assumptions about the distributio of the data.

Counter Example: t-test

(But t-test is a <u>robust</u> test)

Need for non-parametric tests

- Parametric tests for non-stationarity
  ⟶ Assume a "prior" value for data descriptor and look for changes from this value.
- But "prior" estimated from non-stationa data itself !!
- Many channels + adaptive estimation of priors
  ⟹ STATISTICAL CHAOS !

False alarm rate from Monte Carlo simulation

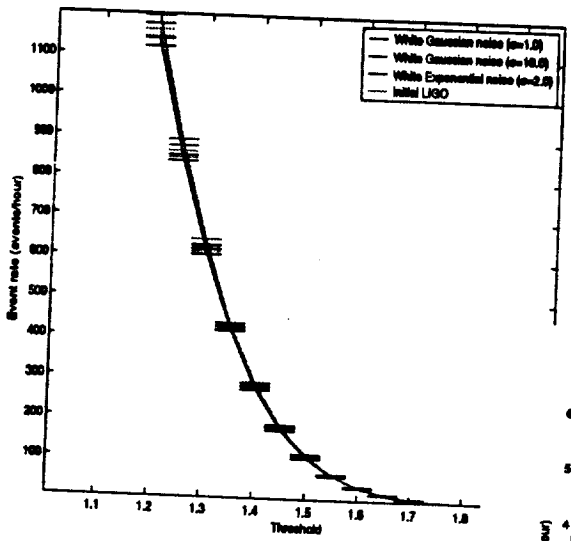
◆Fix test parameters L, N and l .

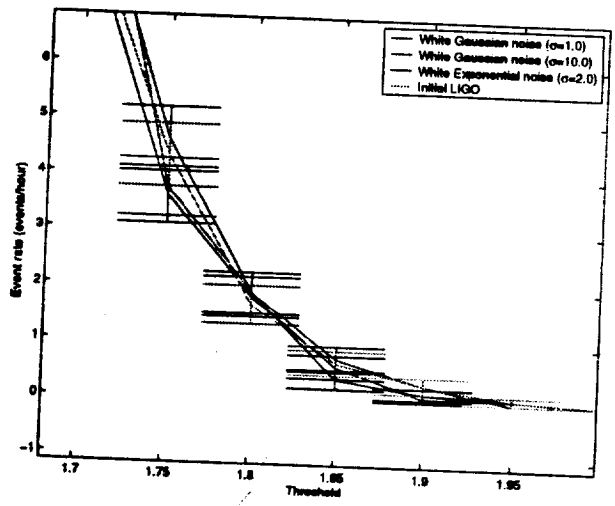
Input : Different Noise distributions:

Gaussian, Exponential

Different Noise PSDs :

White, Coloured (LIGO I).



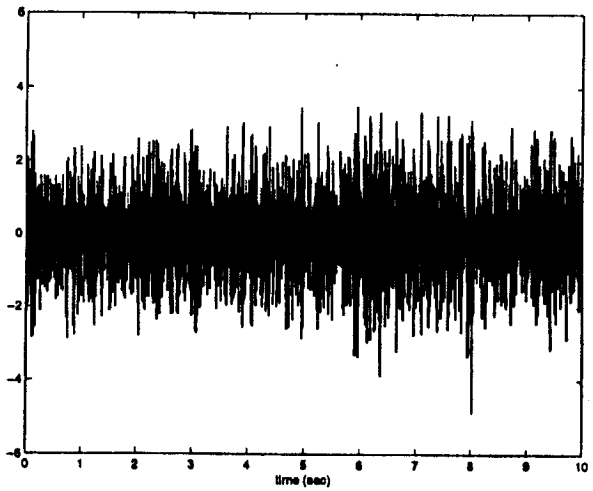


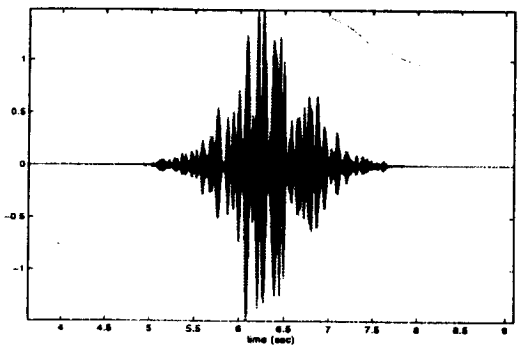
Note : false alarm rate independent of distribution and color of data.

Power of test

Fix false alarm rate at ~ 1 / hour.

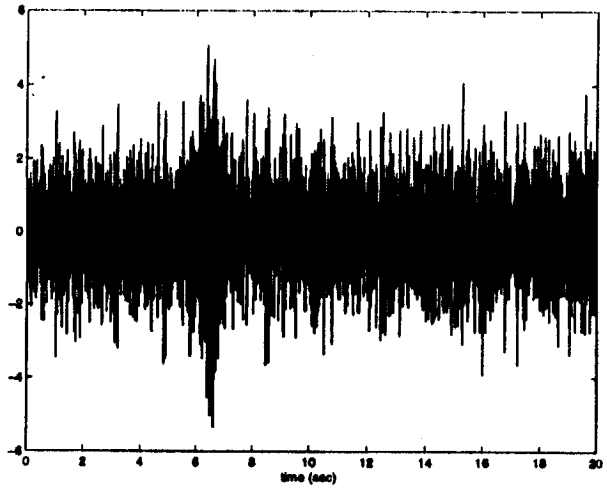
Gaussian noise (LIGO-I PSD) plus narrowband Gaussian noise burst (center frequency 200Hz).

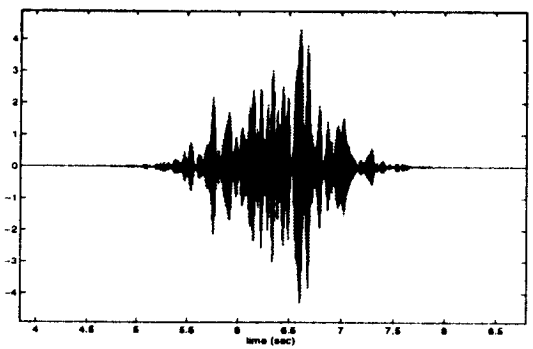




Peak amplitude required for 80% detection probability : 1.5σ

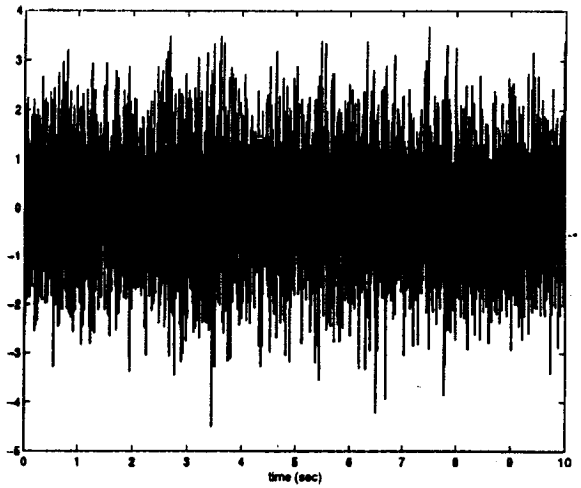
Center frequency of burst is 100Hz.

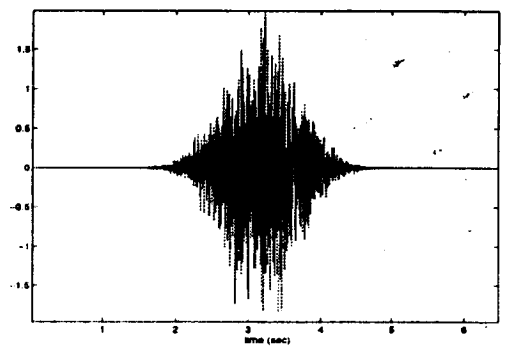




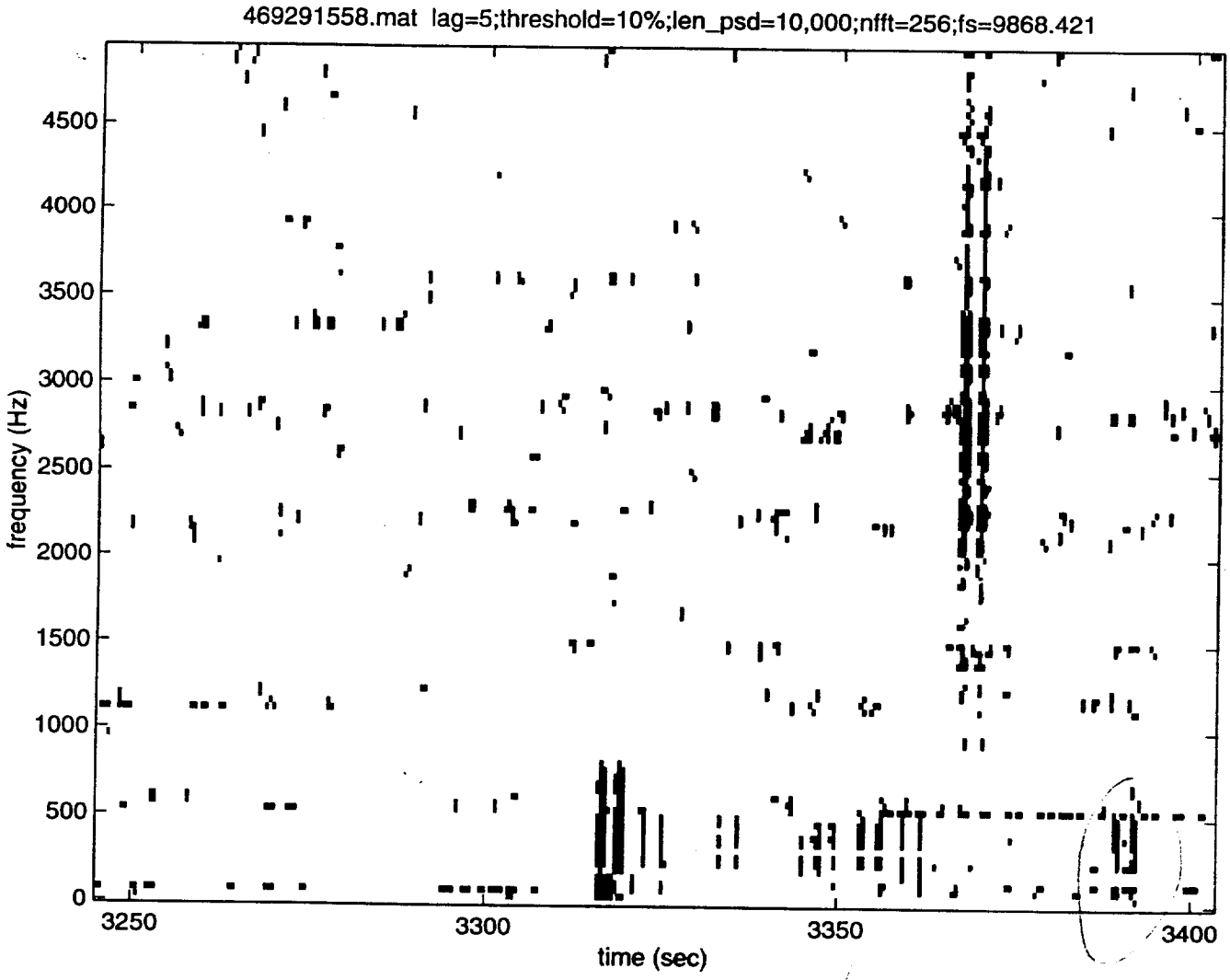
4.3σ

White Gaussian noise plus white Gaussian noise burst





2.0σ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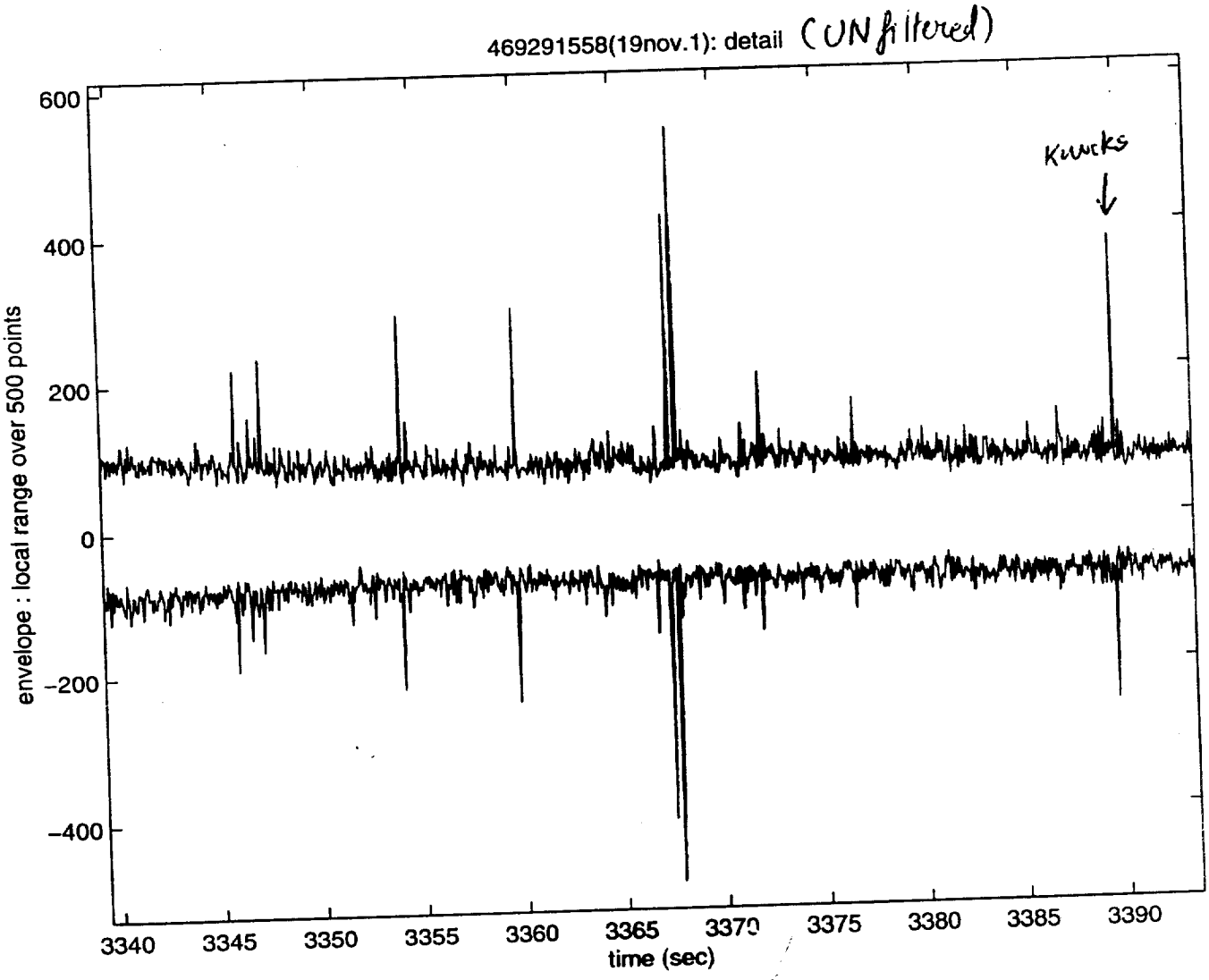
4000
3500
3000
2500
2000
1500
1000
500
0
3250
3300
3350
3400
time (sec)


469291558(19nov.1): detail (UNfiltered)
Knocks
600
400
200
0
-200
-400
envelope : local range over 500 points
3340
3345
3350
3355
3360
3365
3370
3375
3380
3385
3390
time (sec)

Conclusions

- User friendly (No information overload)
- "Clean" test (Simple enough to make out what's going wrong!)
- Computationally trivial (fast)
- STATISTICALLY WELL CHARACTERIZED ("SAFE" because ROBUST)
- Surprisingly powerful (peak amplitude $\lesssim 4\sigma$)
- Problem of narrowband features
  - * Use either cleaned data OR
  - * simply notch the lines

Note 1, Linda Turner, 08/17/99 09:09:01 PM
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