Noise analysis
Exercises

Elena Cuoco1

1European Gravitational Observatory
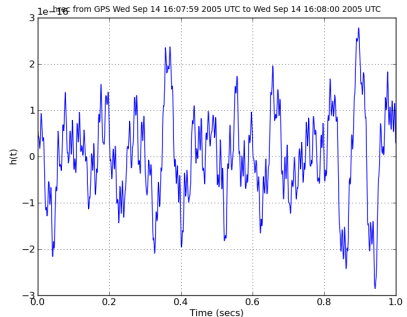
Winter VESF School, 2010

Outline

Read data and plot

- Read data and plot them
- *Initialization file:*TimeDomain/Init.ini
- *Script*: TimeDomain/TD.py

COMMENTS

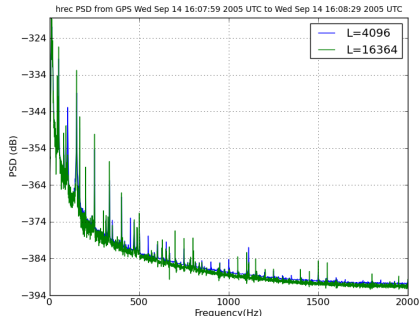- Which kind of information could you extract by these plots?

Outline

1. **Exercises**
   - Time domain
   - **Frequency domain**
   - Time Frequency
   - Transient detection analysis

Compute PSD. Try different lenght

The power spectral density by Welch's average periodogram method.
The vector x is divided into NFFT length blocks.
If len(x) < NFFT, it will be zero padded to NFFT.

- Read data, estimate the PSD and plot.
- Change the parameters for the PSD:lenght of input and NFFT
- *Initialization file*: PSD.ini
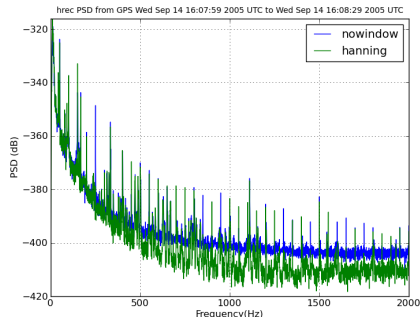- *Script*:PSD.py

COMMENTS
- Which kind of information could you extract by these plots?

Leakage problem. Try different windows

- Read data, estimate the PSD and plot.
- Change the parameters for the PSD: lenght
- *Initialization file*: leakage.ini
- *Script*:leakage.py

hrec PSD from GPS Wed Sep 14 16:07:59 2005 UTC to Wed Sep 14 16:08:29 2005 UTC

COMMENTS

- Which kind of information could you extract by these plots?

Parametric fit

Let's now try to fit the data with an AR process and let's change the number of parameters we use.

- Read data, estimate the PSD and plot using parametric modeling.
- Change the parameters for the PSD: lenght of learning, number of parameters AR model
- *Initialization file*: AR.ini
- *Script*:AR.py
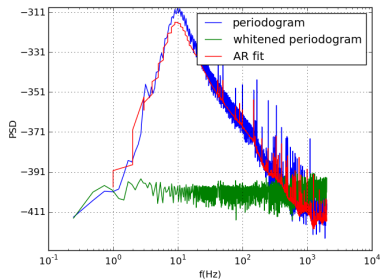
COMMENTS:

- What changes increasing the number of parameters?
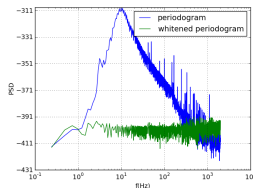- What changes increasing the lenght of input data?

Whitening. How many parameters?

Let's now try to whiten the data using the AR filter and let's change the number of parameters we use.

- Read data, estimate the AR parameters and whiten the data.

- Change the parameters : lenght of learning, number of parameters AR model

- *Initialization file*: Whitening.ini

- *Script*:Whitening.py

COMMENTS:

- What changes increasing the number of parameters?
- What changes increasing the lenght of input data?
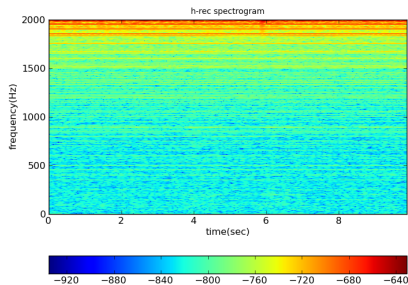- look at the data at different GPS time (use of xmgrace)

Outline

Compute time-frequency representation. Spectrogram

- Read data, estimate the spectrogram.
- Change the parameters : GPS starting time, channel
- *Initialization file*: Spectrogram.ini
- *Script*:Spectrogram.py

COMMENTS:

- What can you extract from this plot?
- See difference at different starting times

Compute wavelet representation. Scalogram

- Read data, estimate the spectrogram.
- Change the parameters : GPS starting time, channel
- *Initialization file*: Wavelet.ini
- *Script*:Wavelet.py

COMMENTS:

- What can you extract from this plot?
- See difference with spectrogram
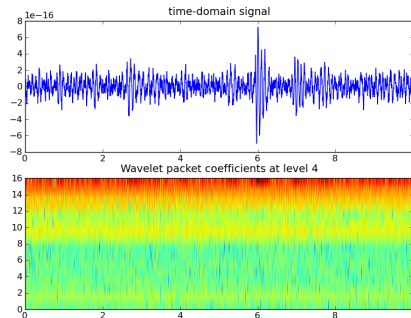
Outline

1. Exercises
   - Time domain
   - Frequency domain
   - Time Frequency
   - Transient detection analysis

Look at glitches

Example

Use one Event trigger generator to create a list of triggers

- Run WDF on the C7 data.
- Change the parameters :
  GPS starting time, threshold
- *Initialization file*: WDF.ini
- *Script*:WDF.py

GPSstart(secs)810745782.255
SNRmax 9.85
Duration(secs) 0.0
CMax(max wavelet coefficient)
5.569681e-18
Freq(Hz) 1695.3125
GPSmax(secs) 810745782.255
Wavelet(type) 'DCT'

Have a look at some triggers

TO-DO

- Select the GPS time of some triggers
- Run the spectrogram on around that GPS time
- Run the spectrogram on whitened data at the sam GPS time
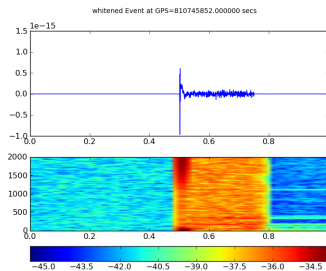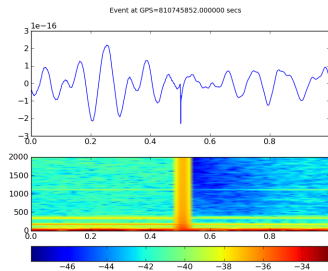
COMMENTS:

For Further Reading I

http://wwwcascina.virgo.infn.it/DataAnalysis/Noise/nap_project.html

http://www.python.org/

http://docs.scipy.org/doc/

http://matplotlib.sourceforge.net/