Hierarchical glitch classification analysis.

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LSC/Virgo Det Char, Baton Rouge, March 21, 2007

LIGO-G070064-00-0

A quick walk through …

•This study involves implementation of classification methods (non-parametric/hierarchical and parametric) to see presence of structures in higher dimensional parameter space. Often features embedded in higher dimensions are not elucidated in simple 1 or 2 dimensional study.

•References for LIGO classification analysis: Past LSC, F2F and GWDAW talks, Burst and Glitch group telecons, published paper in CQG).

•kleine Welle *(Blackburn, L. et. al. 2005 LIGO-050158-00-Z)* is an algorithm that picks up burst triggers from the gravitational wave, auxiliary and environmental channels in LIGO. It generates several gigabytes of trigger database containing information about the physical properties of the burst triggers. The purpose of this analysis is to mine the trigger database to see if the triggers can be categorized in different groups that share common properties. This will lead to effective dimensionality reduction of the problem since the number expected groups will be a countable small number and each group, to some extent, uniform in character. The physical motivation here is that this could become a powerful veto mechanism.

What is new since last LSC meeting

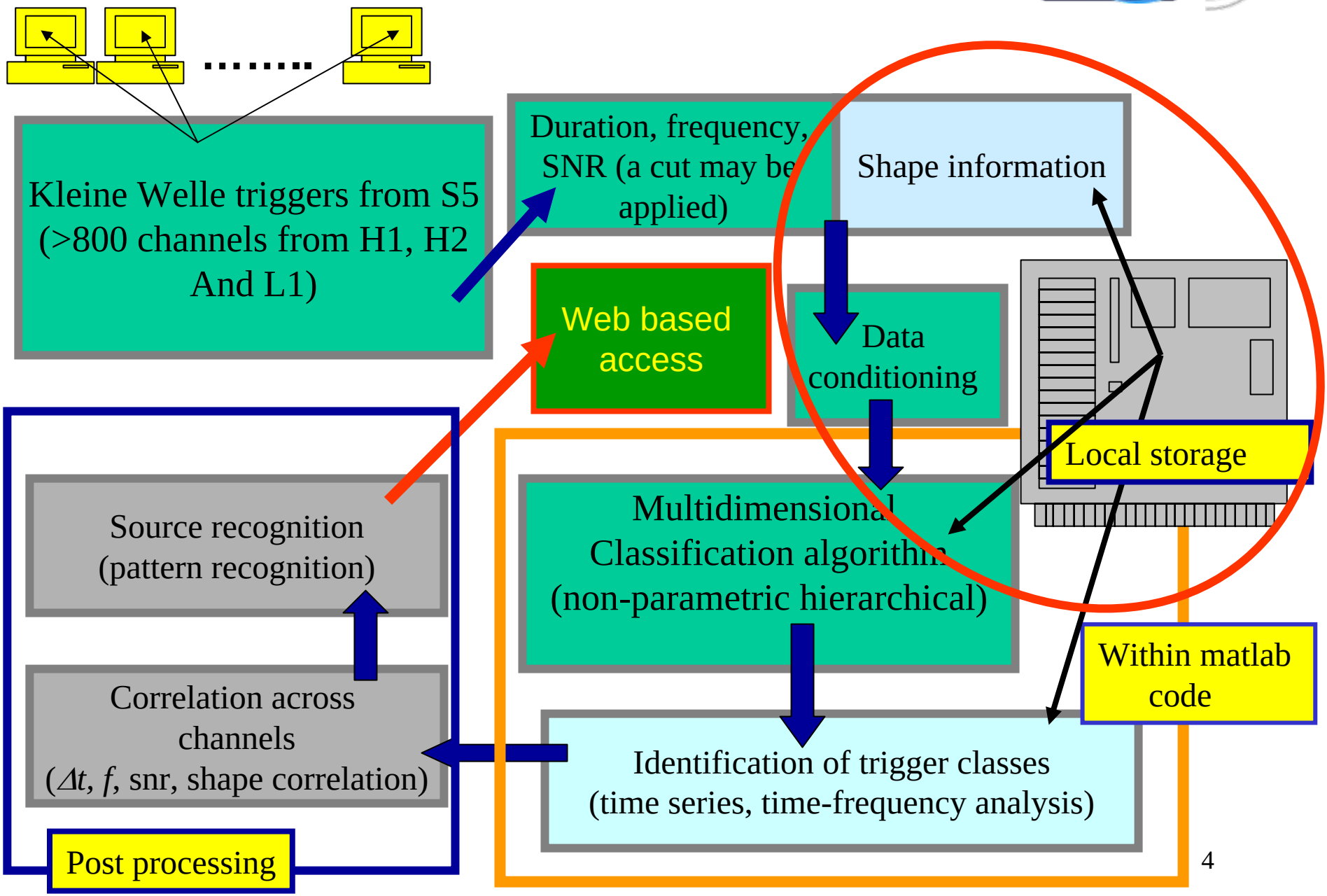
- We start with the kleineWelle trigger database from all channels.
- Data conditioning is applied to clean the narrowband features.
- Analysis database is constructed with Δt, frequency and snr and shape data. Shape information is retained in the form of 256 data points around the peak time.
- A hierarchical classification algorithm is applied.
- At the end of the pipeline, we have information on existing classes (statistics, members,properties) from all channels.

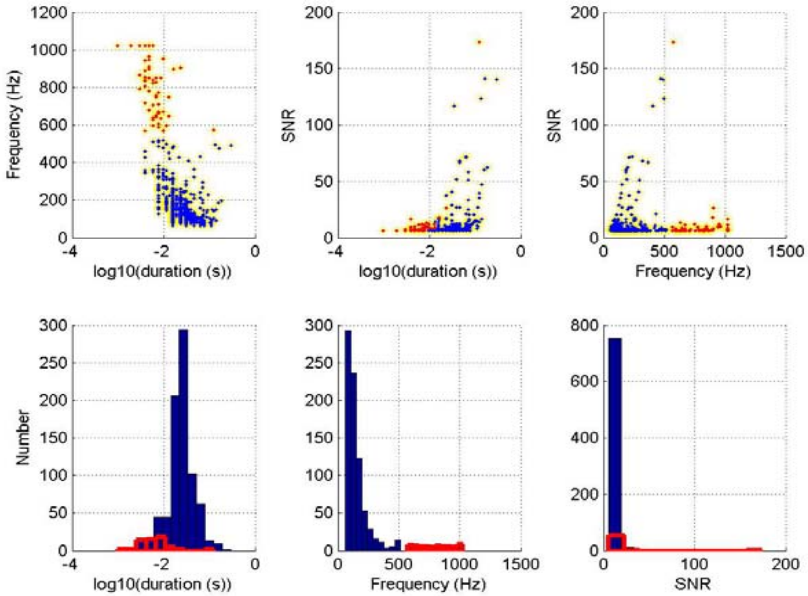
- We need to directly access raw data uninterruptedly. This involves :

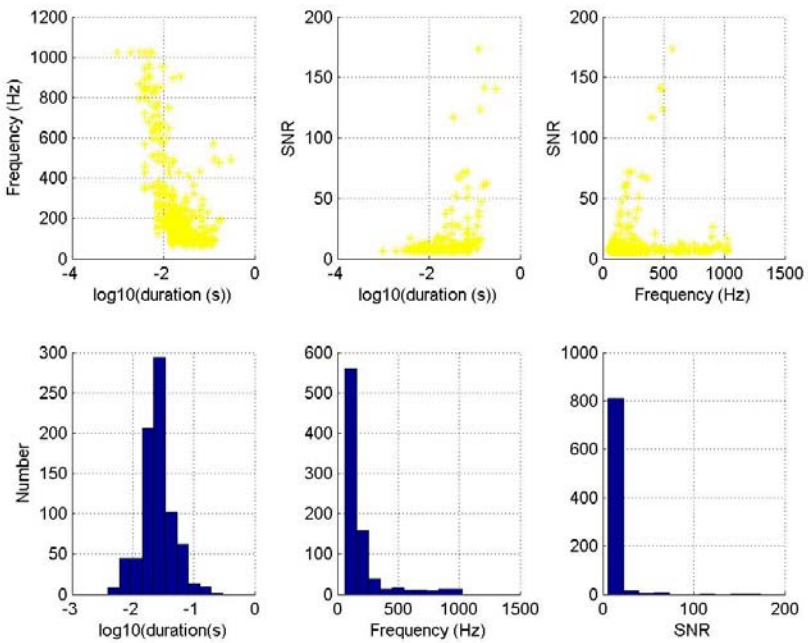
a. Fast connection for rapid data transfer.
b. Data storage.
c. Storage for pipeline output.

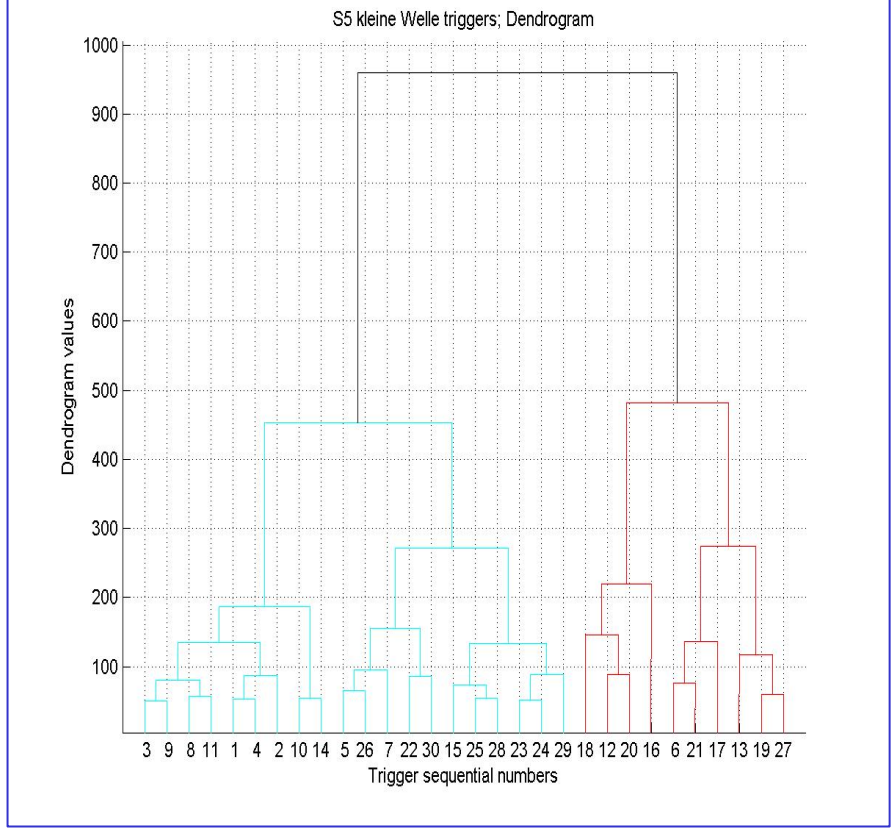
- Identification of the class properties.
- Correlation between channels.
- Formation of class basis.
- Final step towards direct classification based on pattern recognition.

Veto applications.


Kleine Welle triggers from S5 (>800 channels from H1, H2 And L1)
Duration, frequency, SNR (a cut may be applied)
Shape information
Web based access
Data conditioning
Local storage
Source recognition (pattern recognition)
Multidimensional Classification algorithm (non-parametric hierarchical)
Within matlab code
Correlation across channels (Δt, f, snr, shape correlation)
Identification of trigger classes (time series, time-frequency analysis)
Post processing

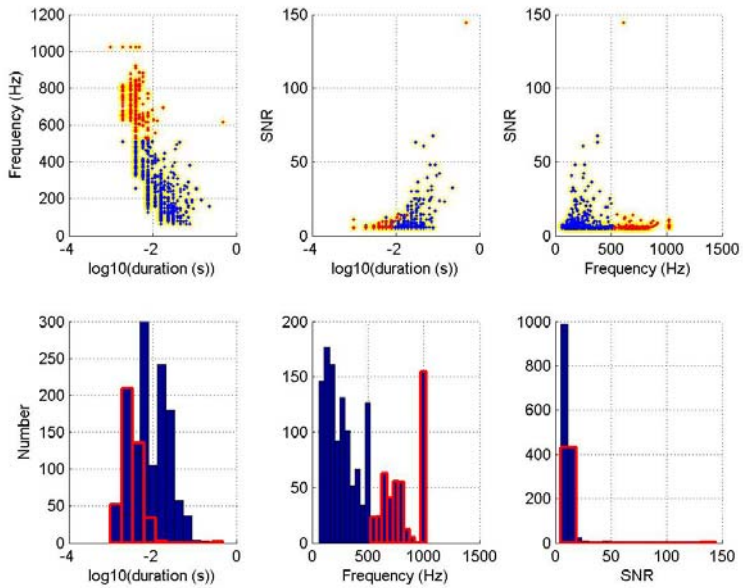


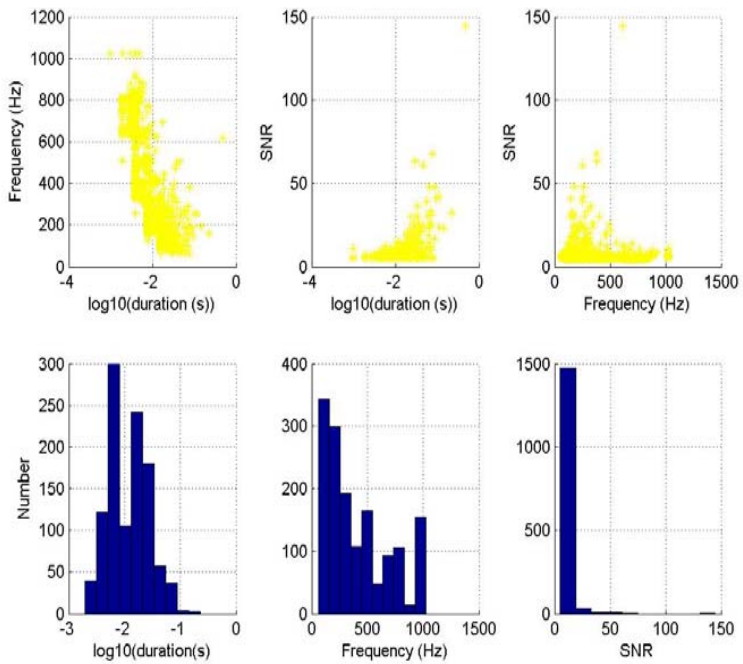


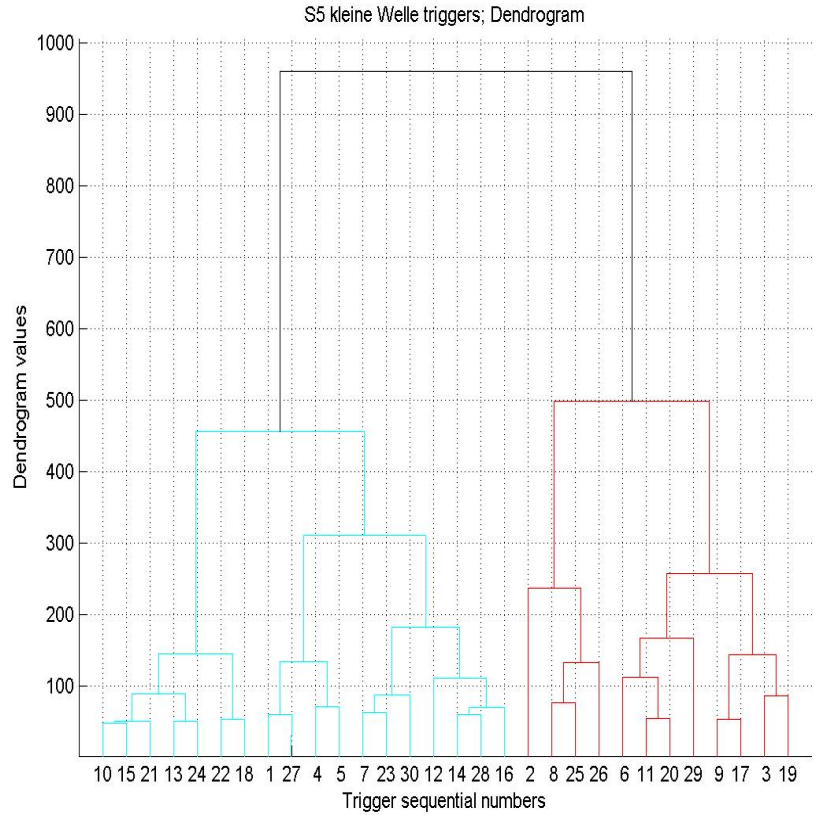


H1:LSC-DARM_ERR

Groups=2, $p<0.003$, $r=0.93$

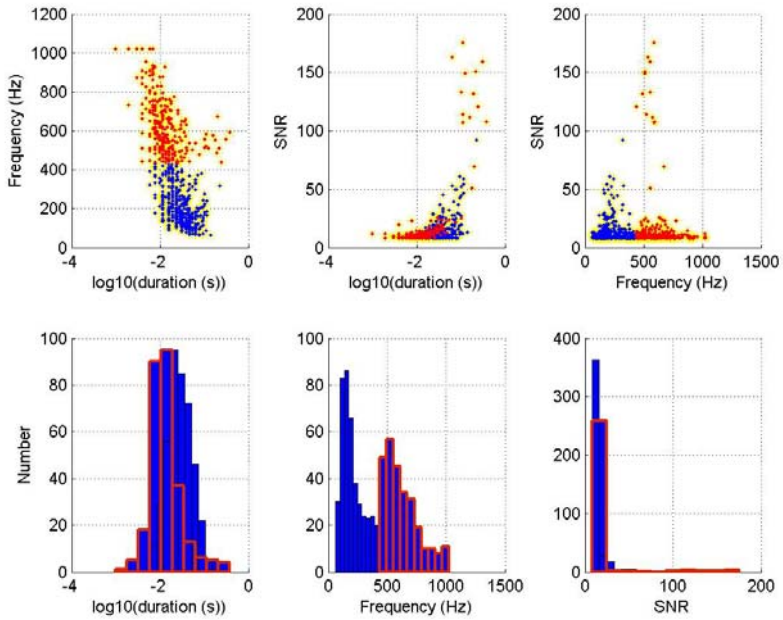


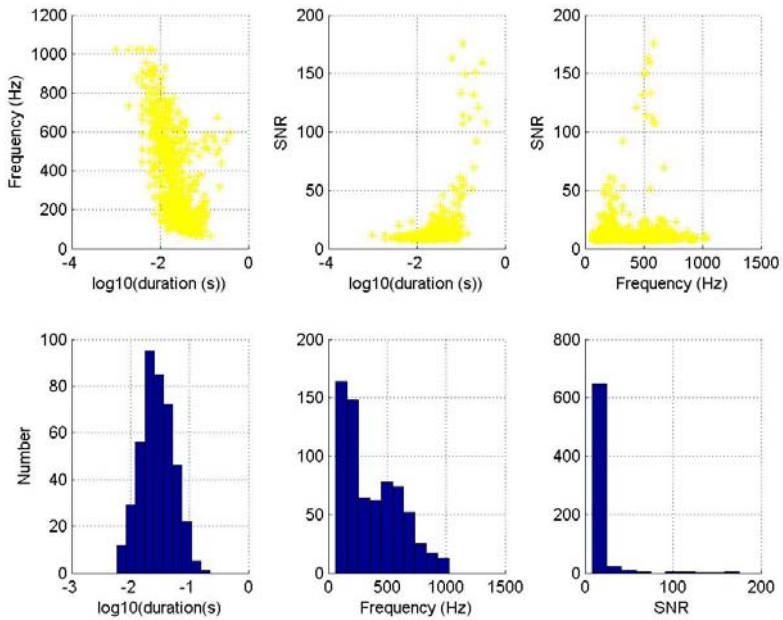


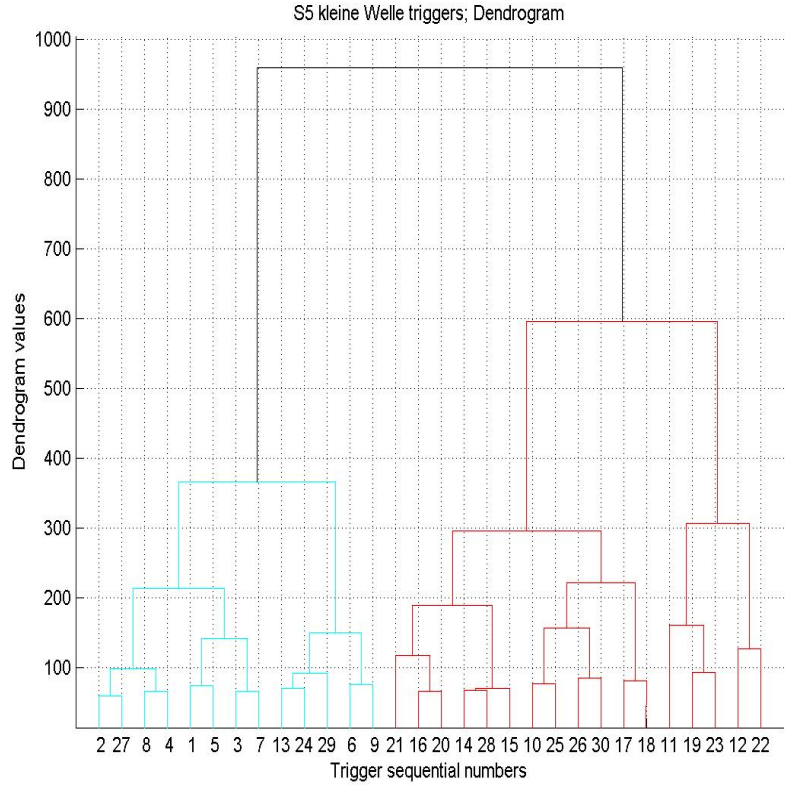


H2:LSC-DARM_ERR

Group=2, p<0.004, r=0.81

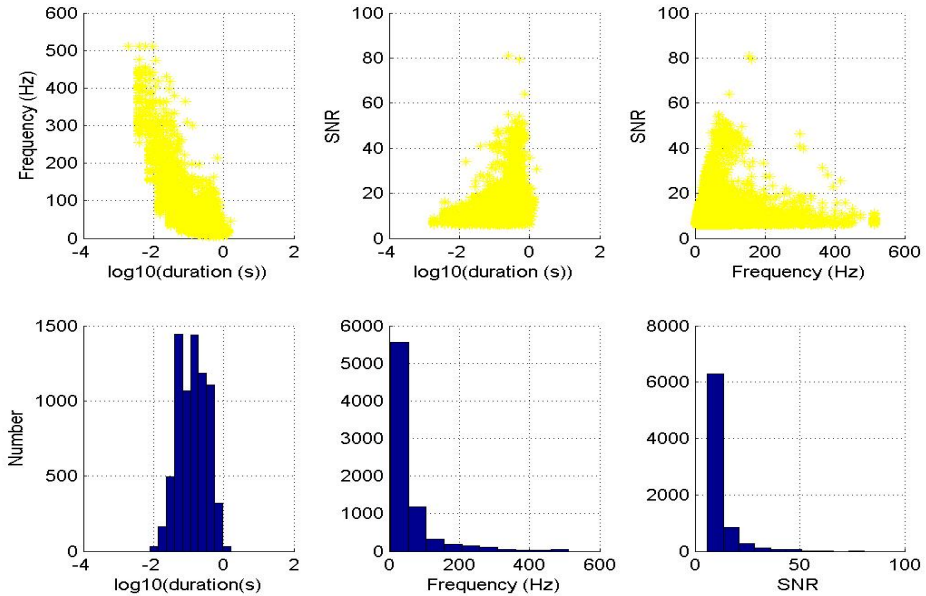


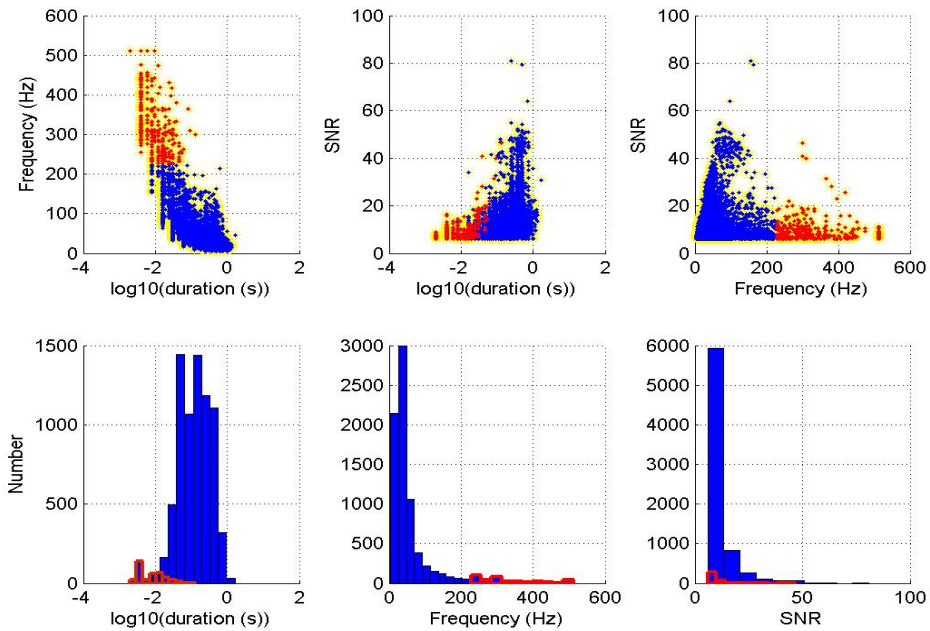




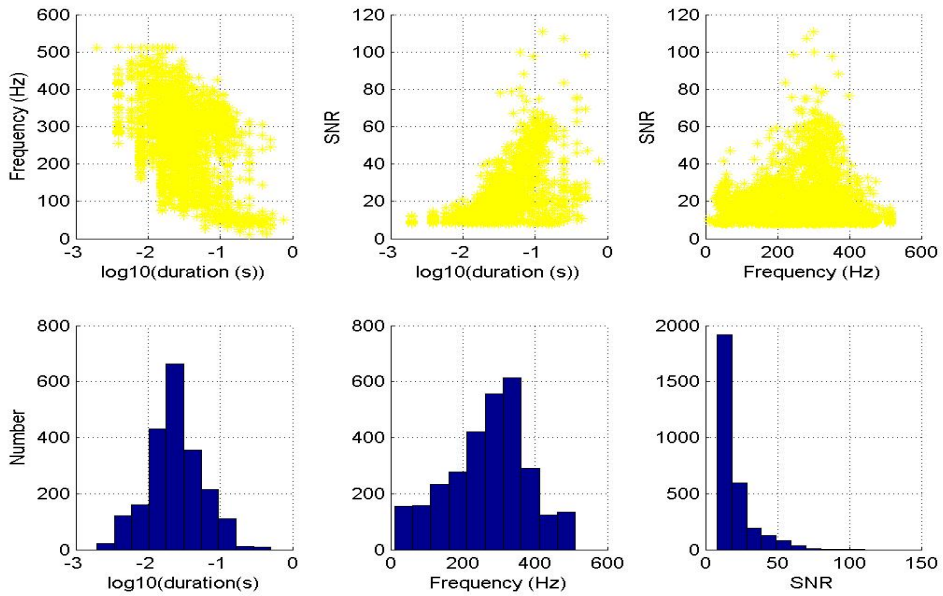
Groups=2, $p<0.04$, $r=0.80$

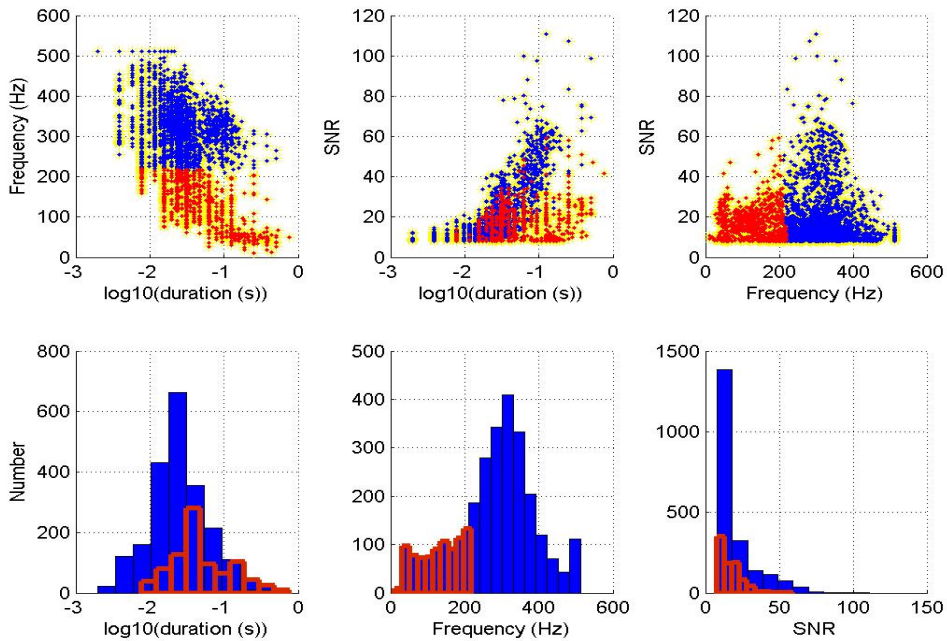
L1:LSC-DARM_ERR



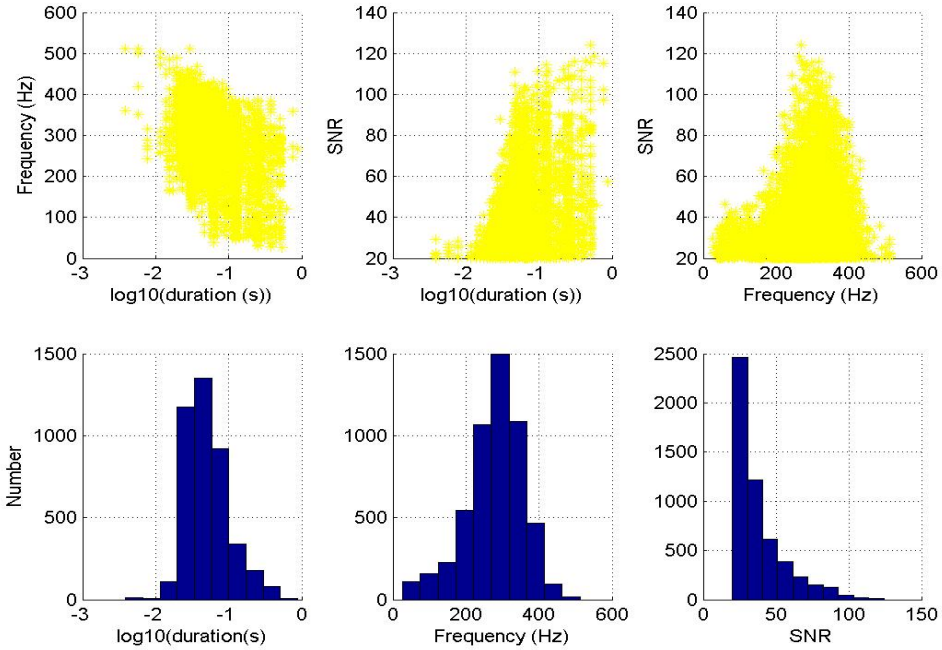


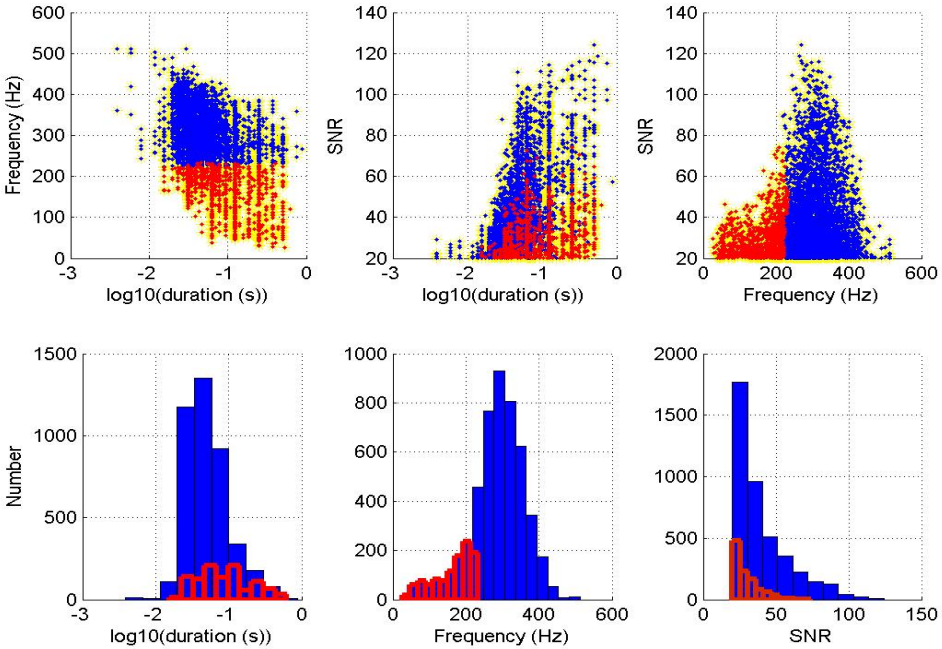
Detector : H0
Channel : BSC6_MAGZ
Number of groups =2
$p < 10e\text{-}6$
r=0.92
n=26304
snr cut = 6
n-surviving = 7669



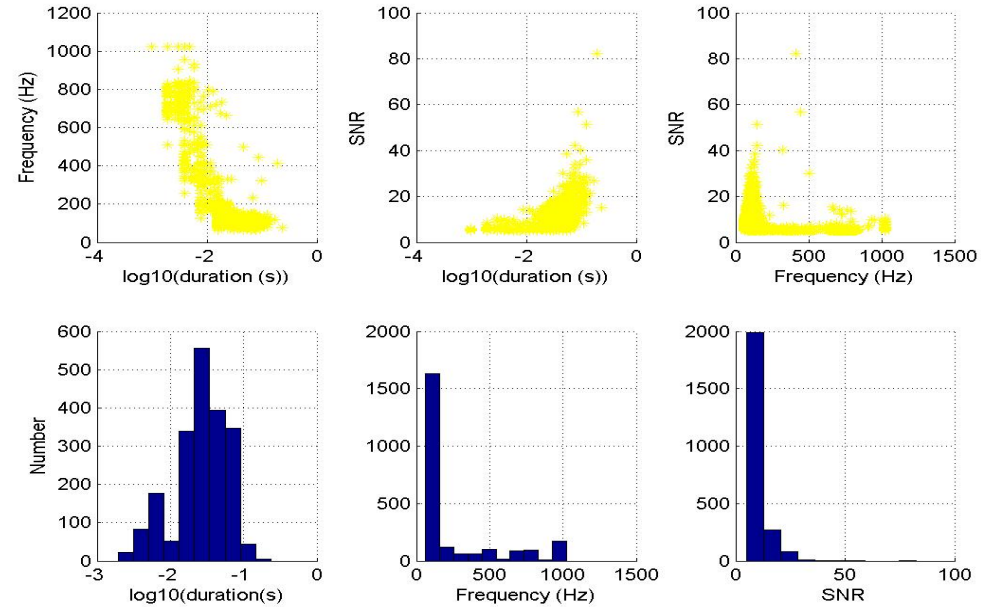


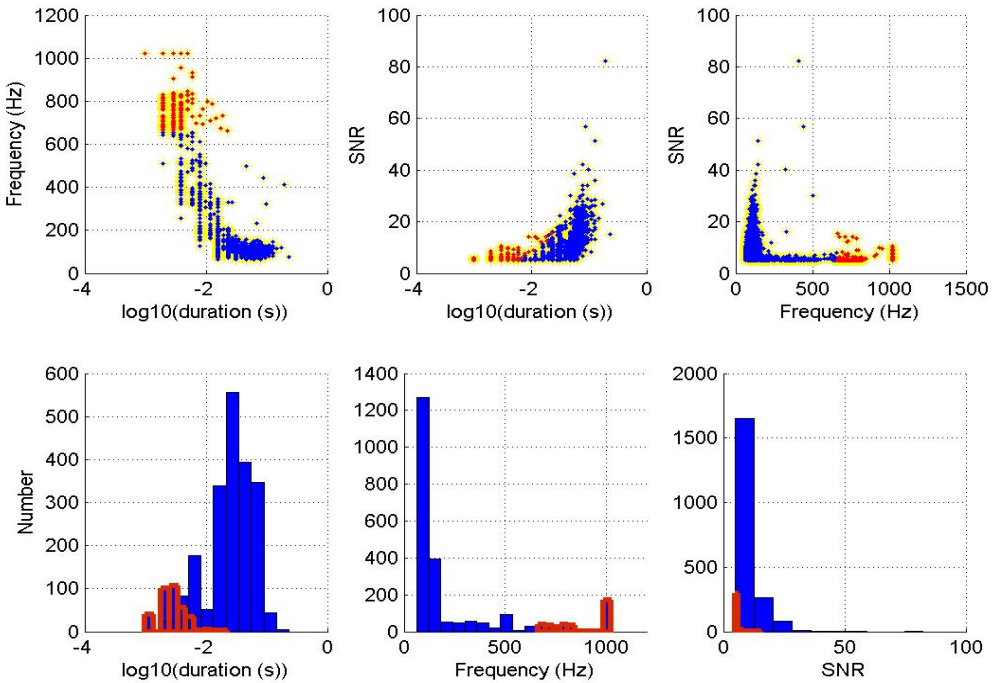
Detector : H1
Channel : COIL_MAGZ
Number of groups =2
$p < 10e\text{-}8$
r=0.70
n=31086
snr cut = 8
n-surviving = 2963



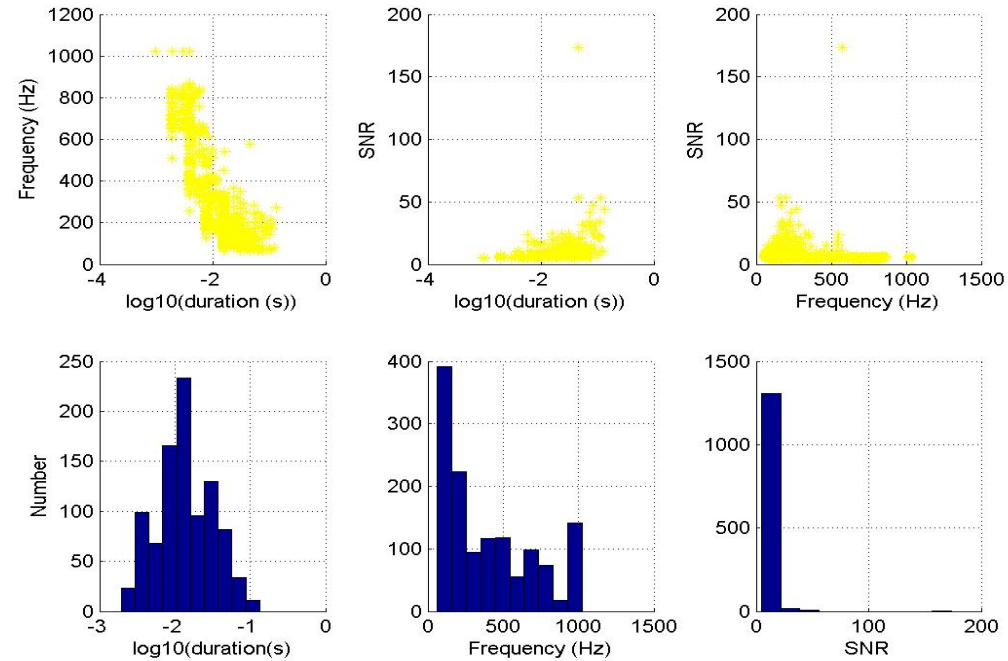


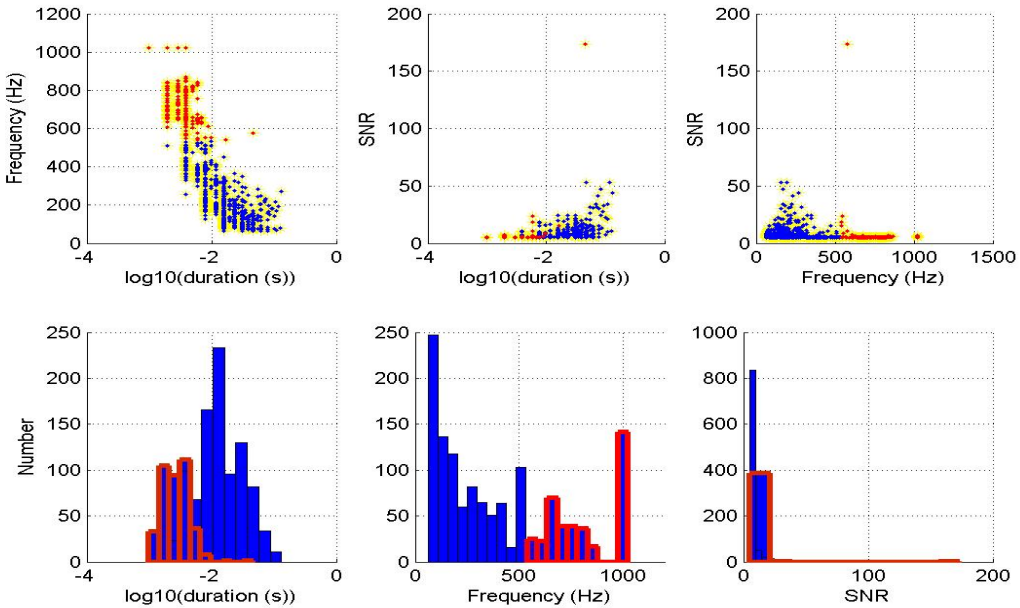
Detector : H1
Channel : COIL_MAGY
Number of groups =2
p < 10e-19
r=0.70
n=64220
snr cut = 20
n-surviving = 5270



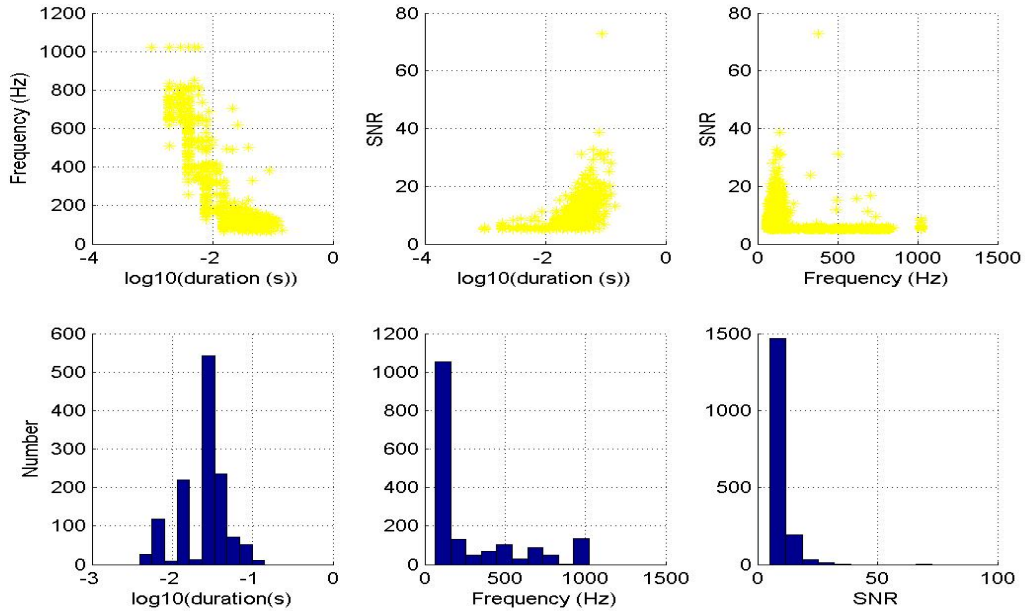


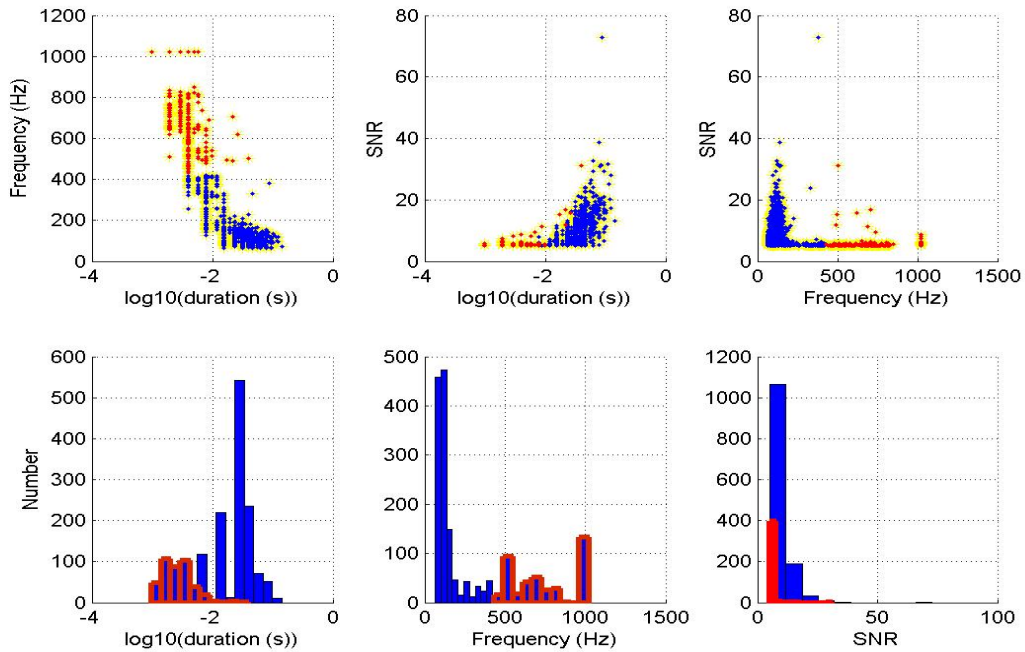
Detector : H1
Channel : MICH_CTRL
Number of groups =2
p < 10e-19
r=0.94
n=17068
snr cut = 5
n-surviving = 2364



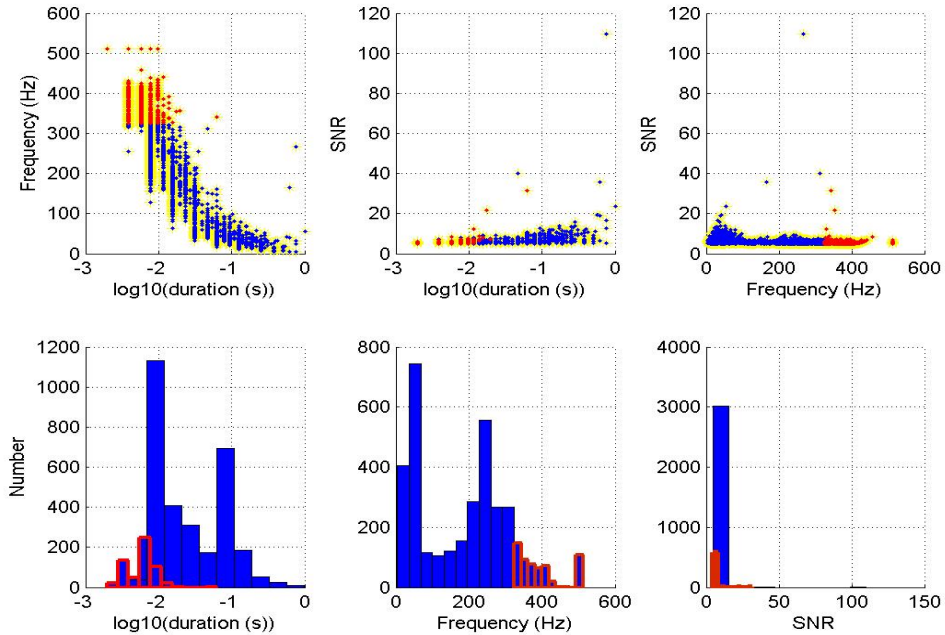


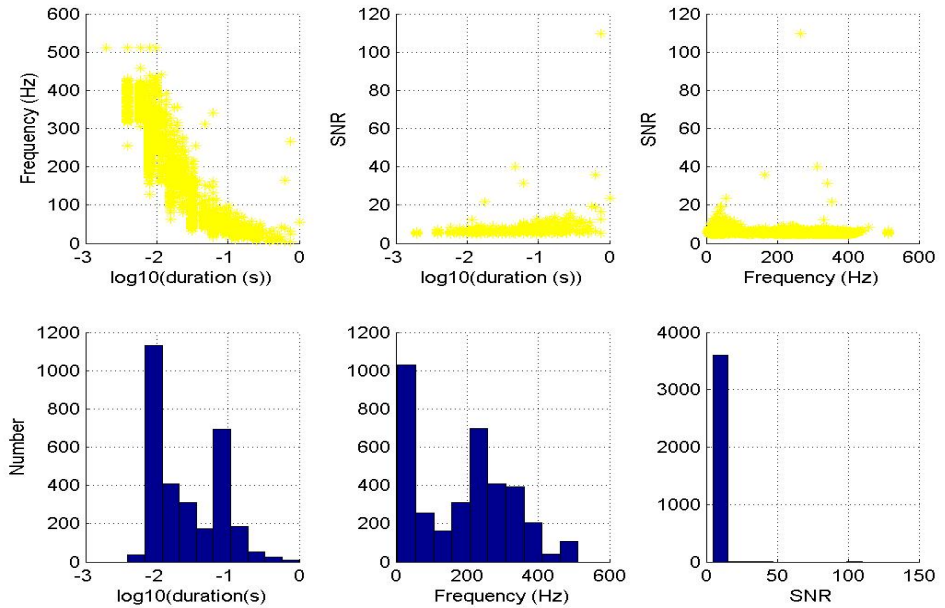
Detector : H2
Channel : POB_I
Number of groups =2
$p < 10e\text{-}15$
r=0.82
n=17096
snr cut = 5
n-surviving = 1331



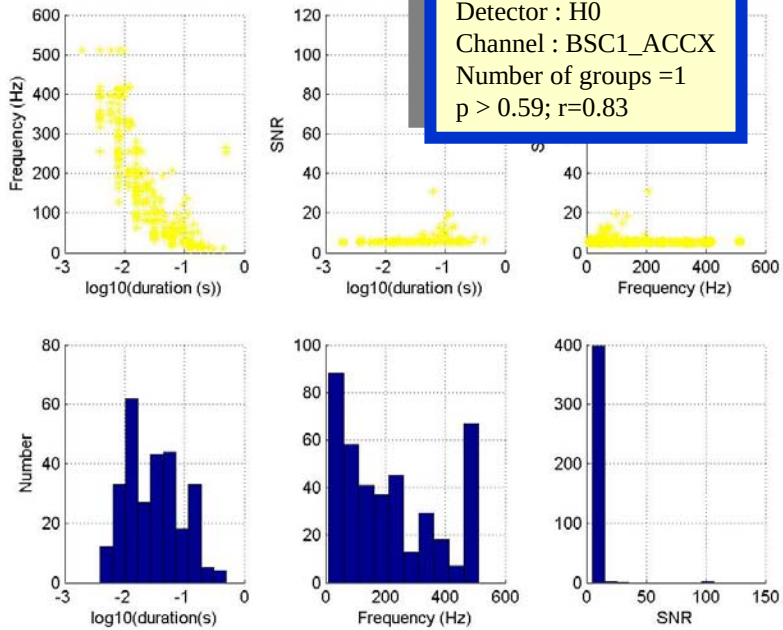


Detector : H1
Channel : POB_I
Number of groups =2
$p < 10e\text{-}8$
r=0.88
n=17779
snr cut = 5
n-surviving = 1706

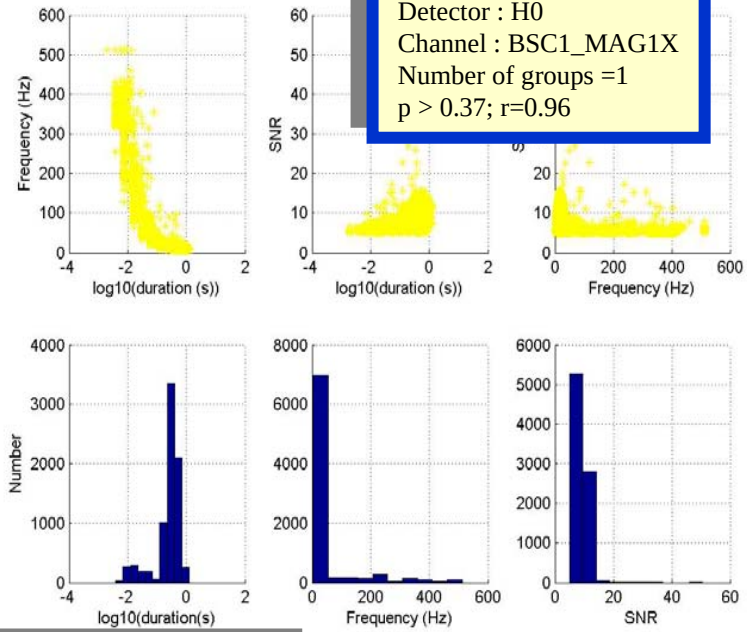




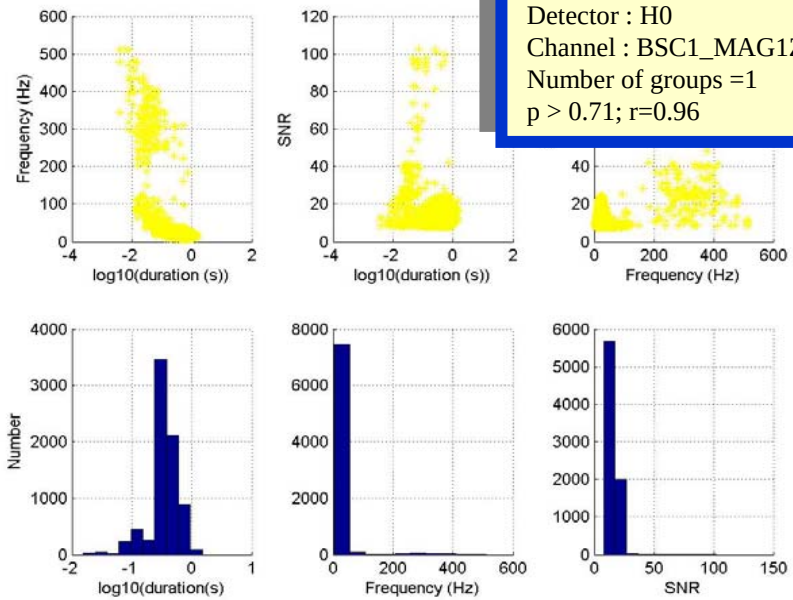
Detector : L1
Channel : ITMX_Y
Number of groups =2
$p < 10e\text{-}9$
r=0.74
n=16508
snr cut = 5
n-surviving = 3609



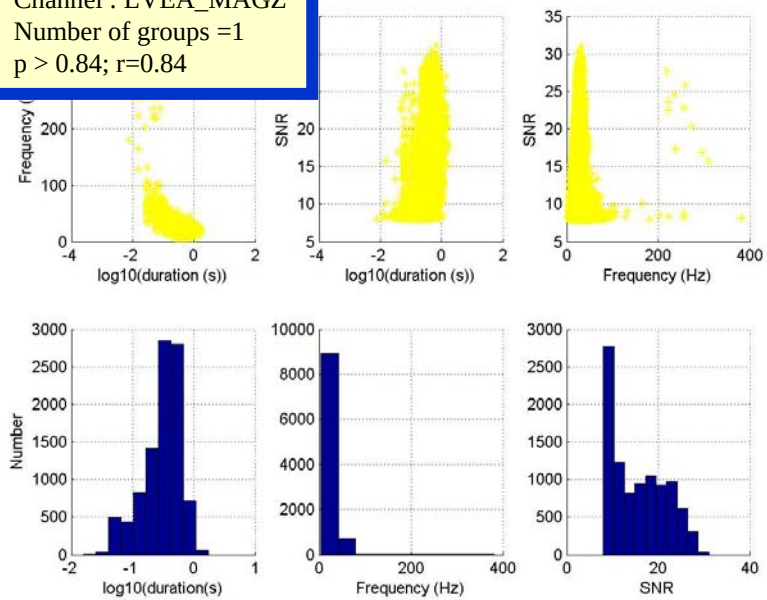
Detector : H0
Channel : BSC1_ACCX
Number of groups =1
p > 0.59; r=0.83



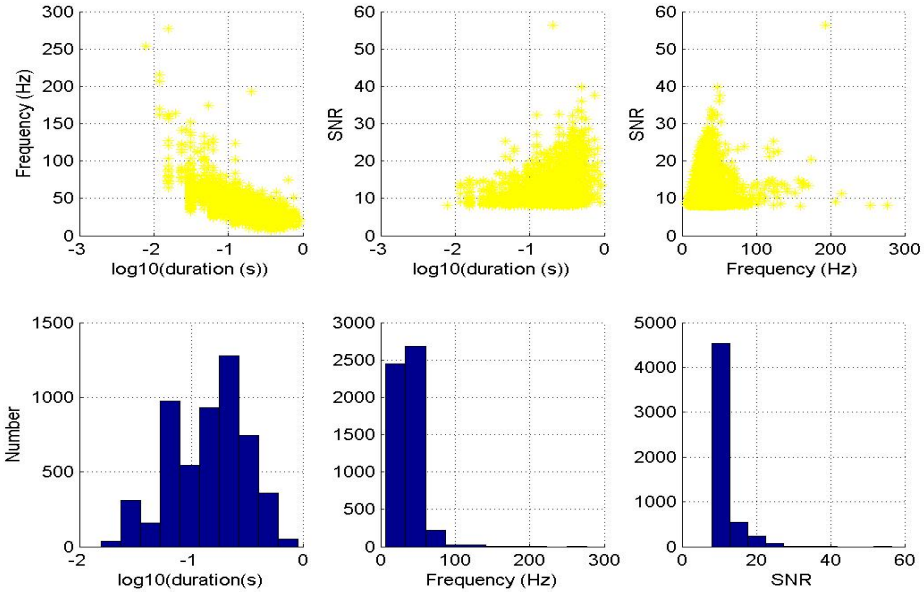
Detector : H0
Channel : BSC1_MAG1X
Number of groups =1
p > 0.37; r=0.96



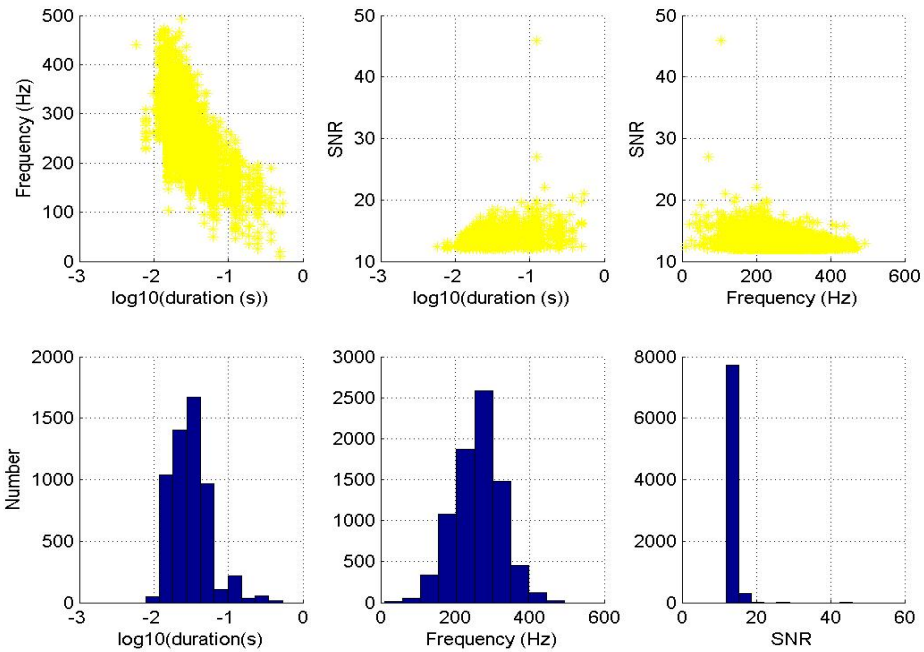
Detector : H0
Channel : BSC1_MAG1Z
Number of groups =1
p > 0.71; r=0.96



Detector : H0
Channel : LVEA_MAGZ
Number of groups =1
p > 0.84; r=0.84



Detector : L0
Channel : LVEA_MAGZ
Number of groups =1
p > 0.90
r=0.79



Detector : L0
Channel : COIL_MAGZ
Number of groups =1
p > 0.24
r=0.64

Time information database

www.phys.utb.edu/~soma/ time_data.mat

- Burst/Glitch/Det Char telecon next week
- GWDAW11 CQG proceedings.

Target & timeline : what's been met and what next

- Main hierarchical classification code in Matlab.
- Hardware/software/bandwidth for uninterrupted data transfer.
- Data storage.
- Code modification to access data for shape information.
- End-to-end test.

- Extend study to coincident triggers.
- Archiving of results in a password protected web page accessible to the collaboration. [May 07 LSC].
- BNS trigger classification.

- Trigger identification – What are these glitches ? Where do they come from ? [August/ November 07]
- Automation.
- Veto.