# Transients Identification

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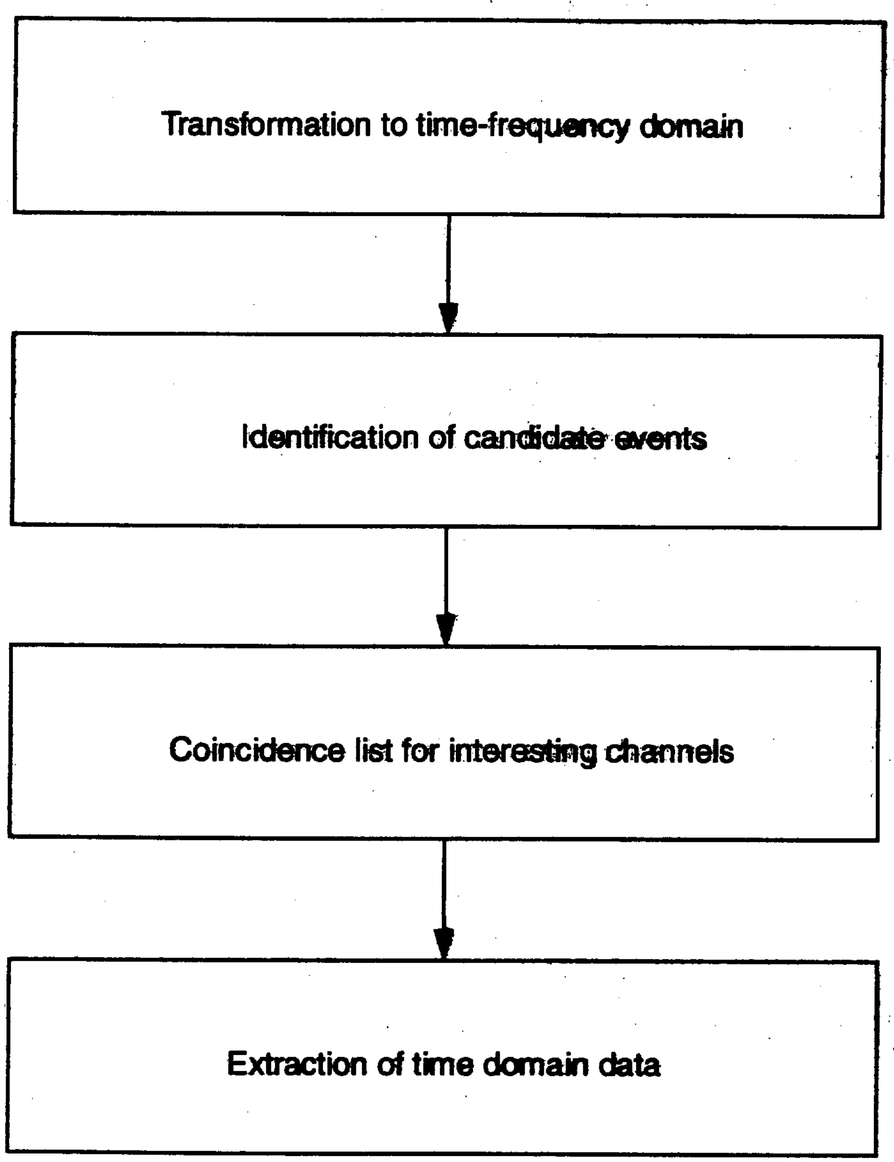
# Transients Identification

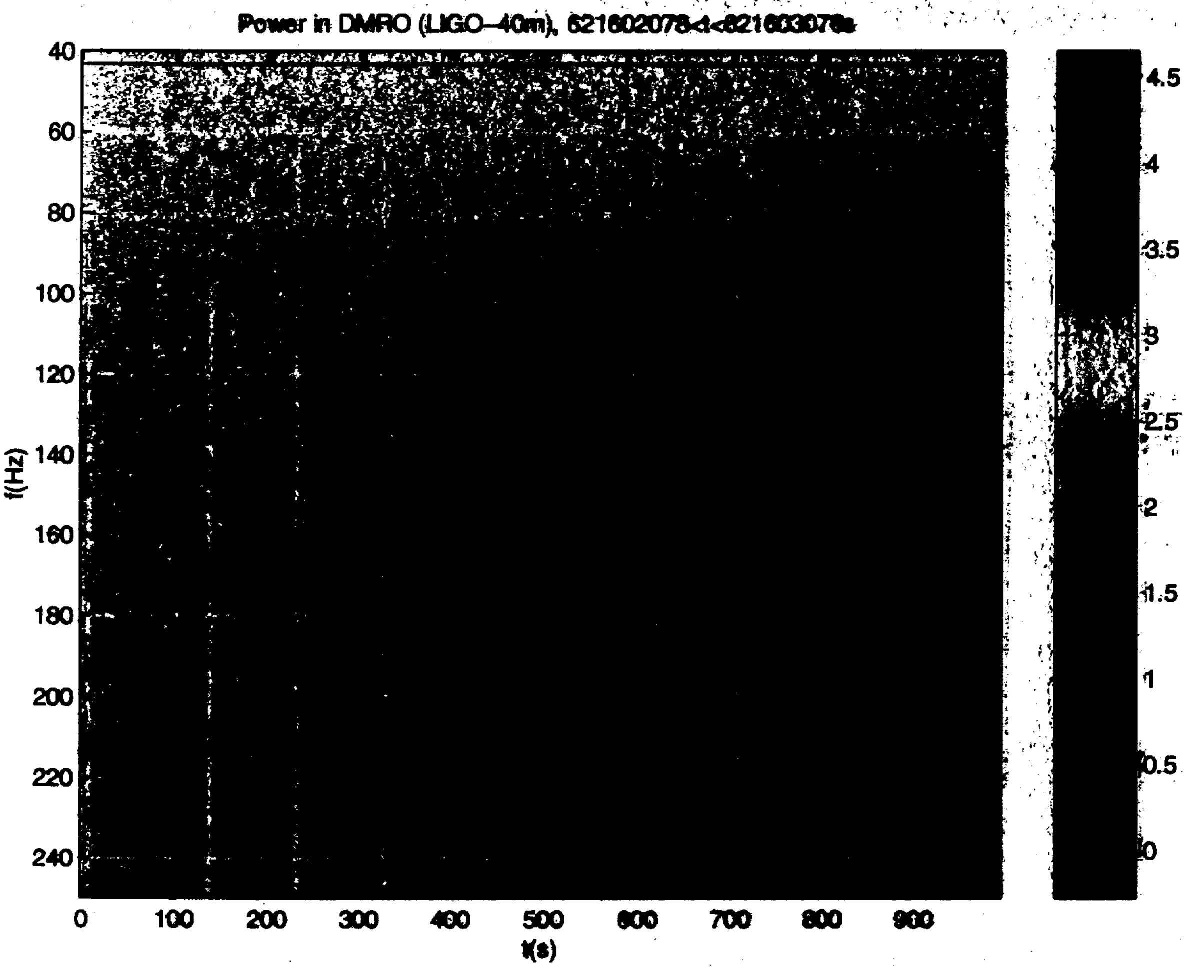
## Pipeline for the extraction of bursts



# Transients Identification

## Time-frequency representation

An example, T=5s, 2.5s overlap, triangular window:



# Transients Identification

## Candidate Events

- A constant frequency slice of the spectrogram has a known distribution, if no transients are present.
- "Robust" against non-gaussian noise by the central limit theorem.

Distribution of power P at some frequency, assuming a true steady signal power Q:

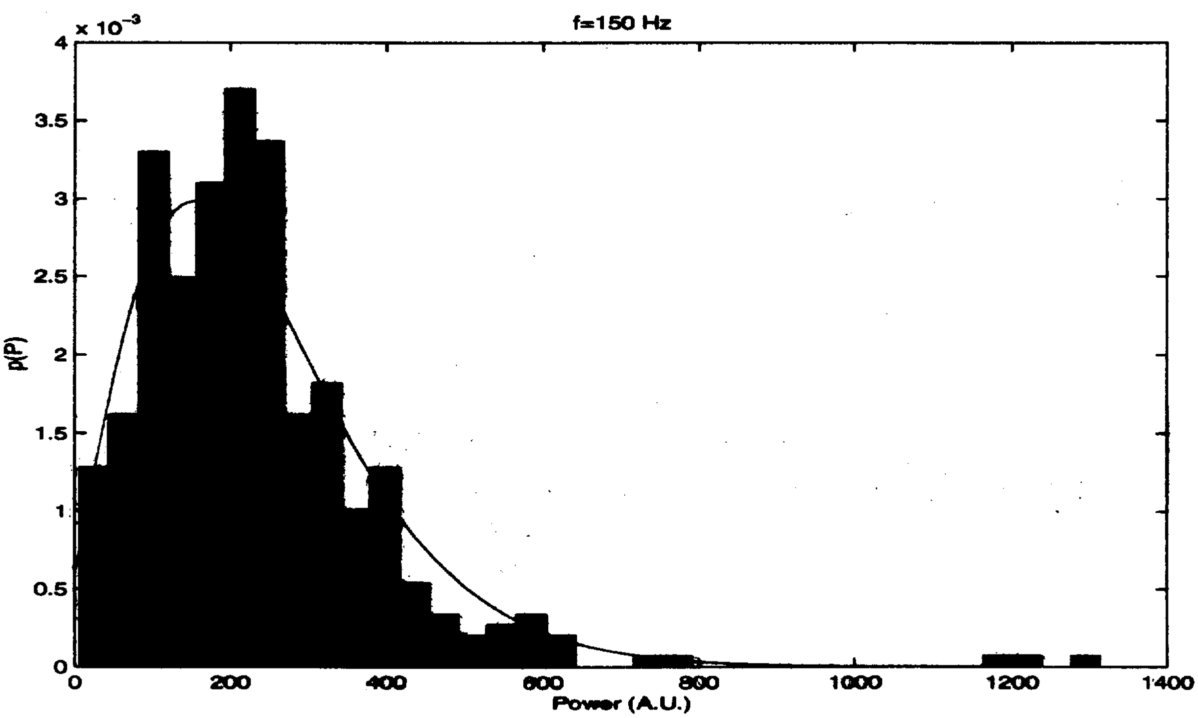
$$p(P|Q) = \frac{1}{P_0} I_0\left(\frac{2\sqrt{PQ}}{P_0}\right) \exp\left(-\frac{(P+Q)}{P_0}\right)$$

So that

$$\mu_P = Q + P_0$$

and

$$\sigma_P^{\ 2} = P_0^{\ 2}$$



# Transients Identification

## Candidate Events

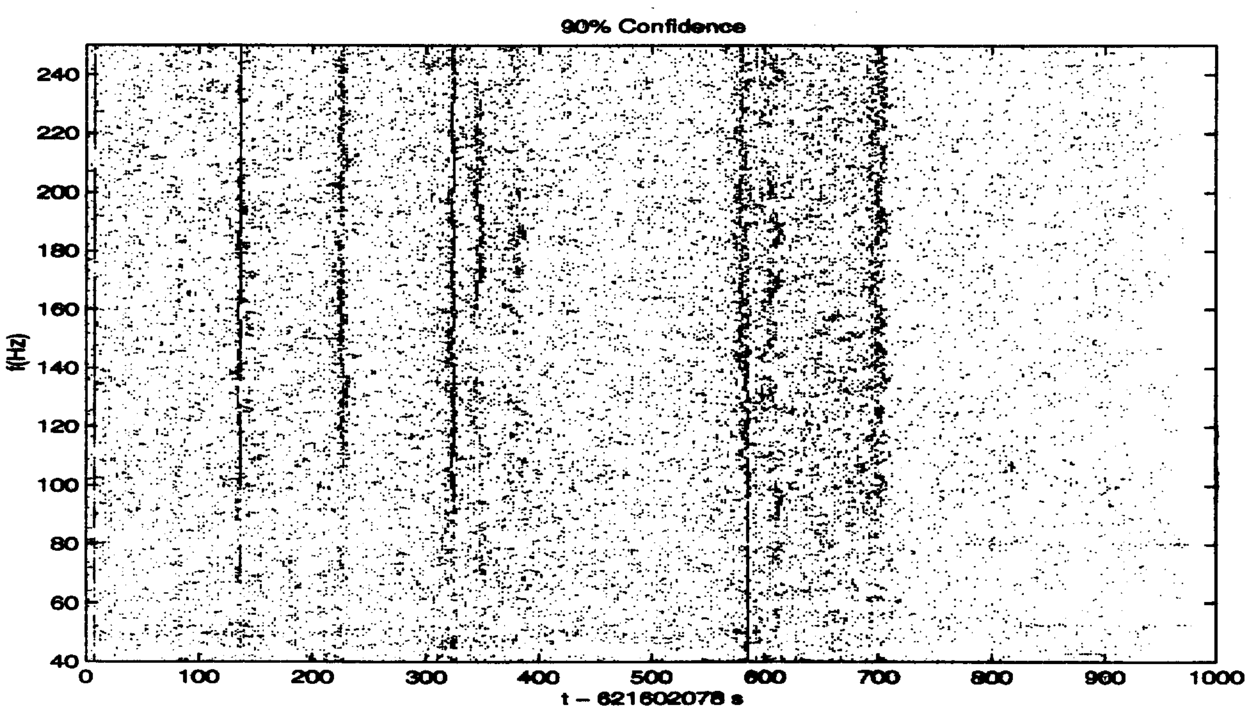
- H0: The noise is distributed according to $p(P|Q)$.

- The parameters are estimated from the sample mean and variance

- For $P$ the maximum value of power, H0 is rejected if the cumulative probability distribution up to $P$ is larger than the confidence of the test.

- The time for which H0 was rejected is recorded and marked as a candidate event. That particular value of time is excised from the frequency slice under consideration, and the test is rerun until H0 is accepted.

The result is the time-frequency location of candidate events:

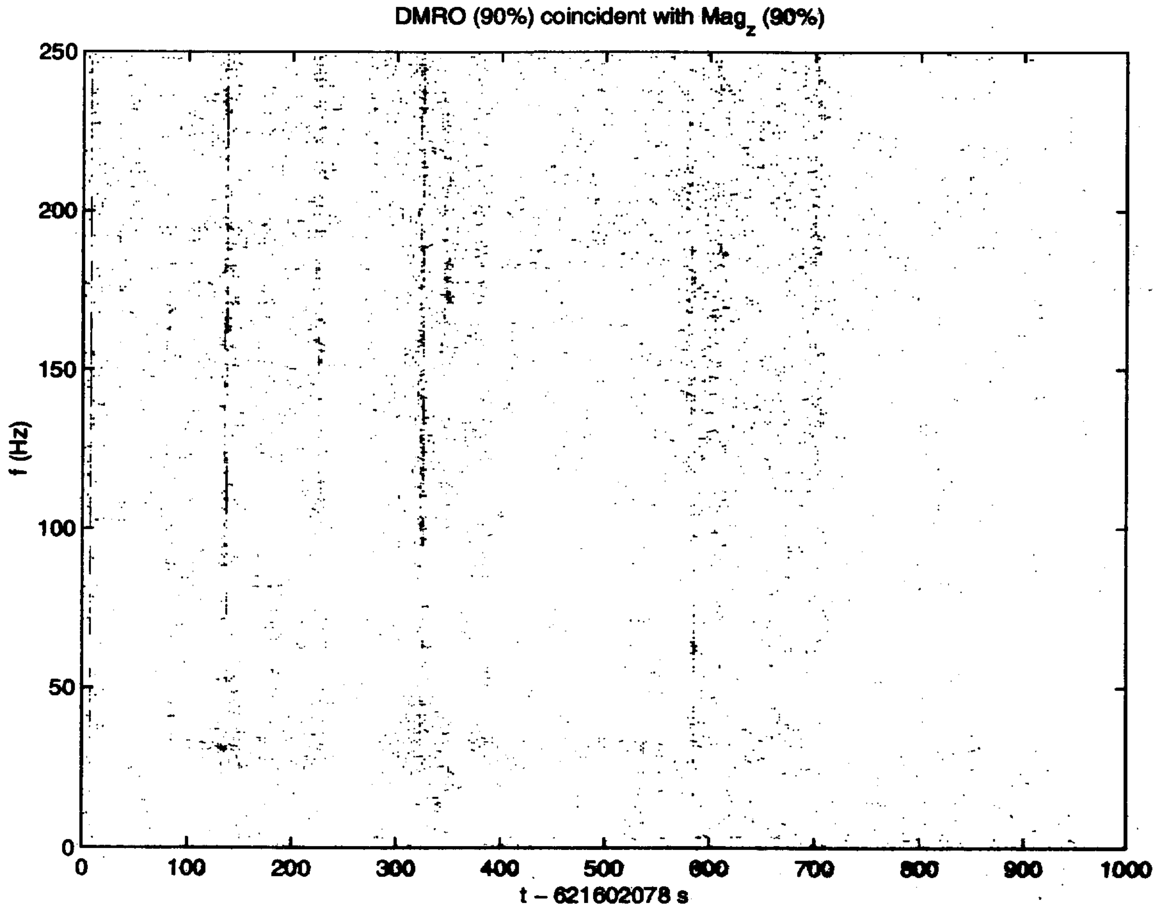


## Transients Identification

### Coincidences List

- Given N channels of particular interest, a coincidence is recorded whenever an event is present in all N channels within a rectangular window of a pre-defined size in the time-frequency domain.

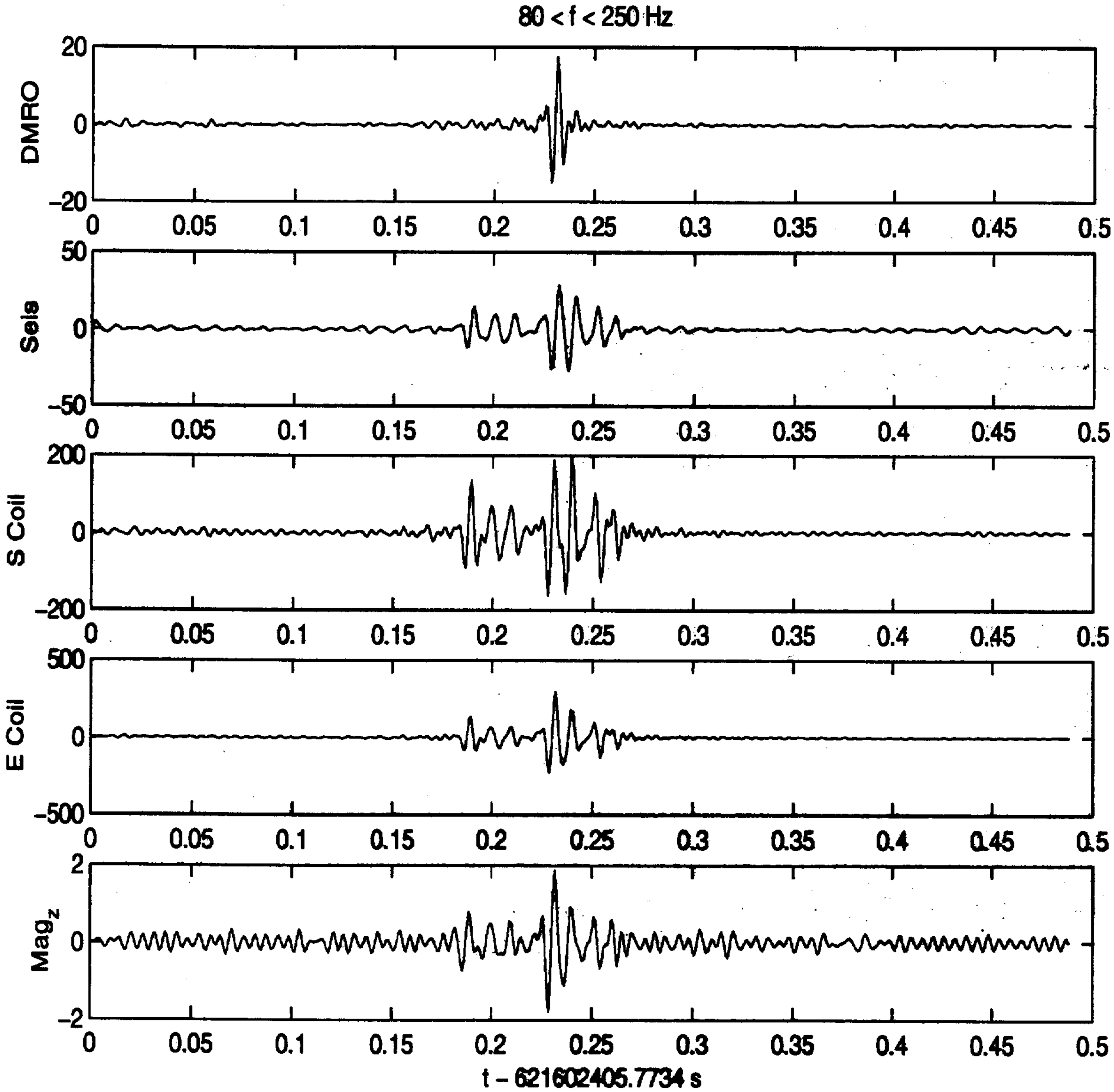
The results is a "cleaner" list of possible locations for transients:



## Transients Identification

### Events in the time-domain

- Interesting events are identified, and the proper regions of the time-frequency domain are extracted.



# Transients Identification

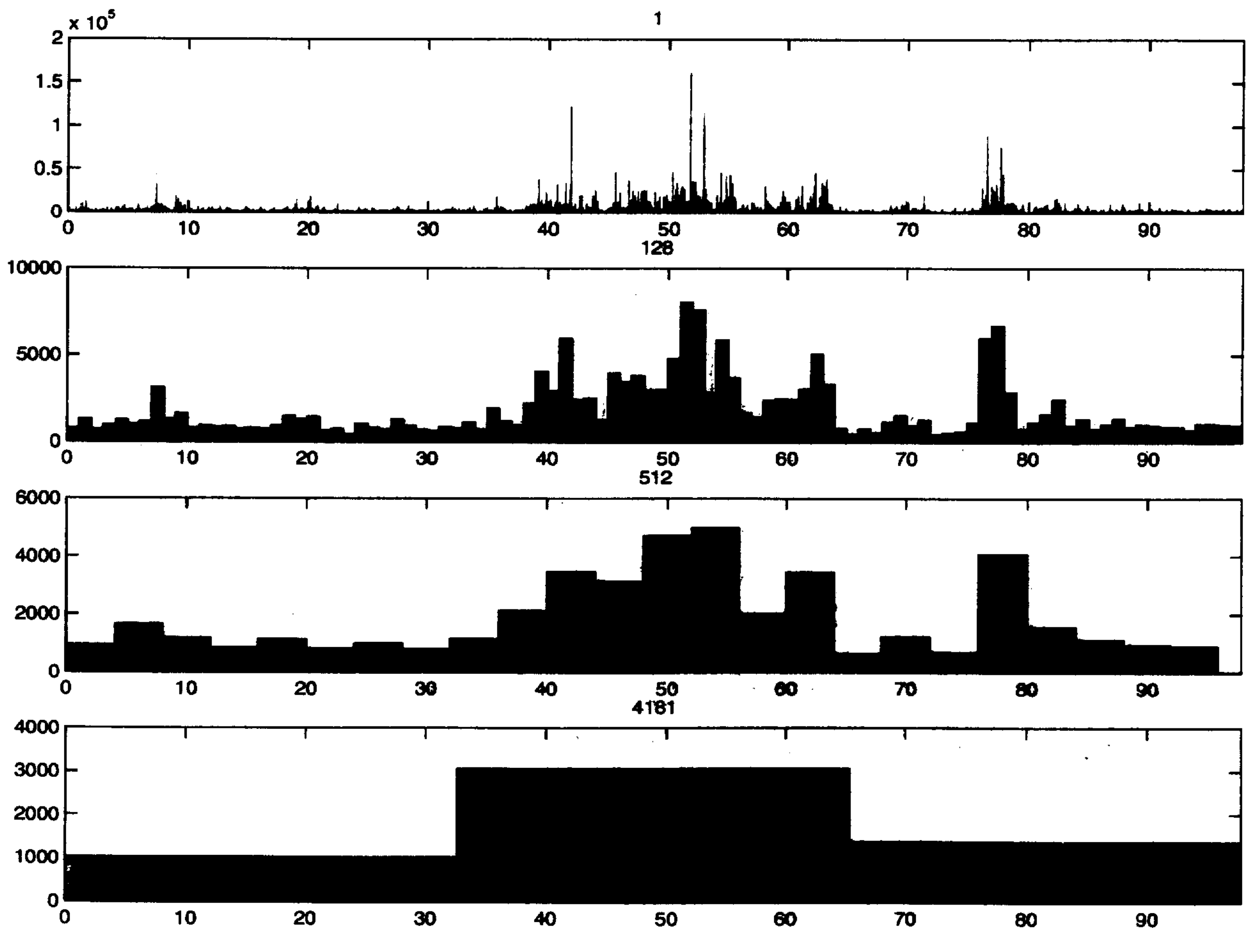
## Models

| | |
|---|---|
| Linear, no delays | Principal Component Analysis<br>Independant Component Analysis<br><br>$y_1(t) = a_{11}x_1(t-T_{11}) + \ldots + e_1(t)$<br><br>$y_2(t) = a_{21}x_1(t-T_{21}) + \ldots + e_2(t)$<br><br>$\ldots$ |
| Linear, delays | Box-Jenkins<br><br>$y(t) = \frac{A_1(q)}{B_1(q)}x_1(t) + \ldots + \frac{C(q)}{D(q)}e(t)$ |
| Non-linear | Variable weighting of large (q>1) / small (q<1) peaks<br><br>$y(t) \to y^q(t)$<br><br>$\hat{y}(f) \to \lvert\hat{y}(f)\rvert^q e^{i \arg \hat{y}(f)}$ |

# Transients Identification

## Time Scale

- There are no reasons, a priori, to expect the statistics of the transients to be dominated by a single time scale. Bursts of different scales may have very different amplitude distributions.
- Identifying properly the relevant scales is crucial in devising a time-frequency analysis technique.
- One approach: Statistics of the excursions above a threshold for (whitened) time series at various resolutions.



*Note 1, Linda Turner, 05/09/00 10:15:44 AM*

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