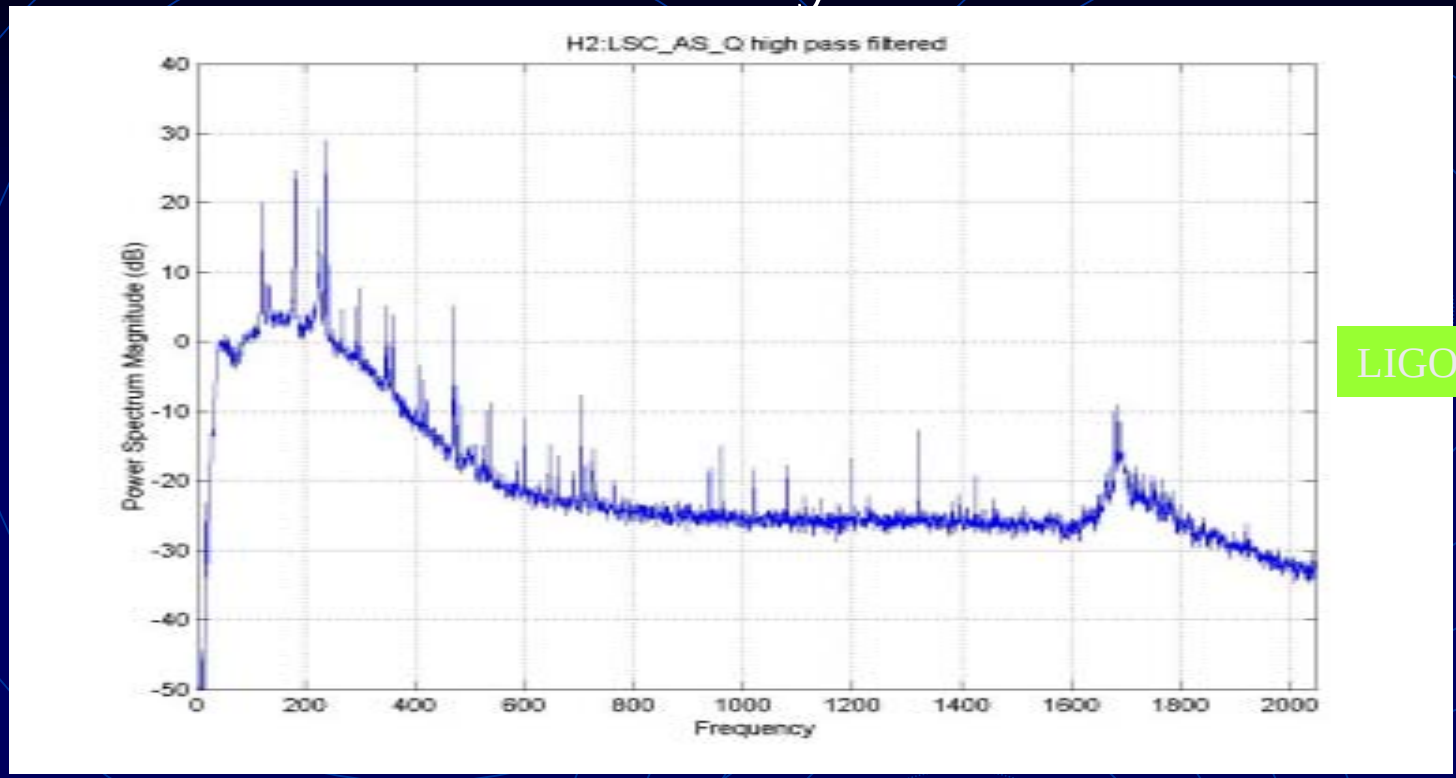
Median Based Line Tracker

Soumya D. Mohanty

Max Planck Insitut für Gravitationsphysik

LIGO-G020034-00-Z

Lines and why remove them



LIGO E7 run

- Lines are not fundamental noise sources (except violin mode thermal noise)
- Effects of lines: examples
  - Higher false alarm rates for transient tests
  - Reduction in efficiency of noise floor non-stationarity tracking.

MBLT: Basic Motivations

(S.D.Mohanty, CQG, 2002)

- Need to have a model independent line removal method
- There are usually more lines than models
  - Violin modes (Kalman filter)
  - Power Lines (CLRT)
- Cross-channel regression requires that the predictor channel have
  - a high SNR for the line to be removed.
  - a stationary noise background (and no strong transients)

MBLT v/s Notch Filters

- Notch filters are model independent
- Subtracting away line estimate found from notch filters takes away power from transients
- If there are a lot of lines, the loss of collective bandwidth can be important
- MBLT was created to be a notch filter that is more robust against transients

Algorithm

- Heterodyne data at every line carrier frequency
- Make a smoothed estimate of the two noisy quadratures
- Modulate a carrier with the smoothed estimates
- Using a running mean for smoothing is equivalent to a notch filter

Use the Running Median instead : rejects outliers unlike the mean

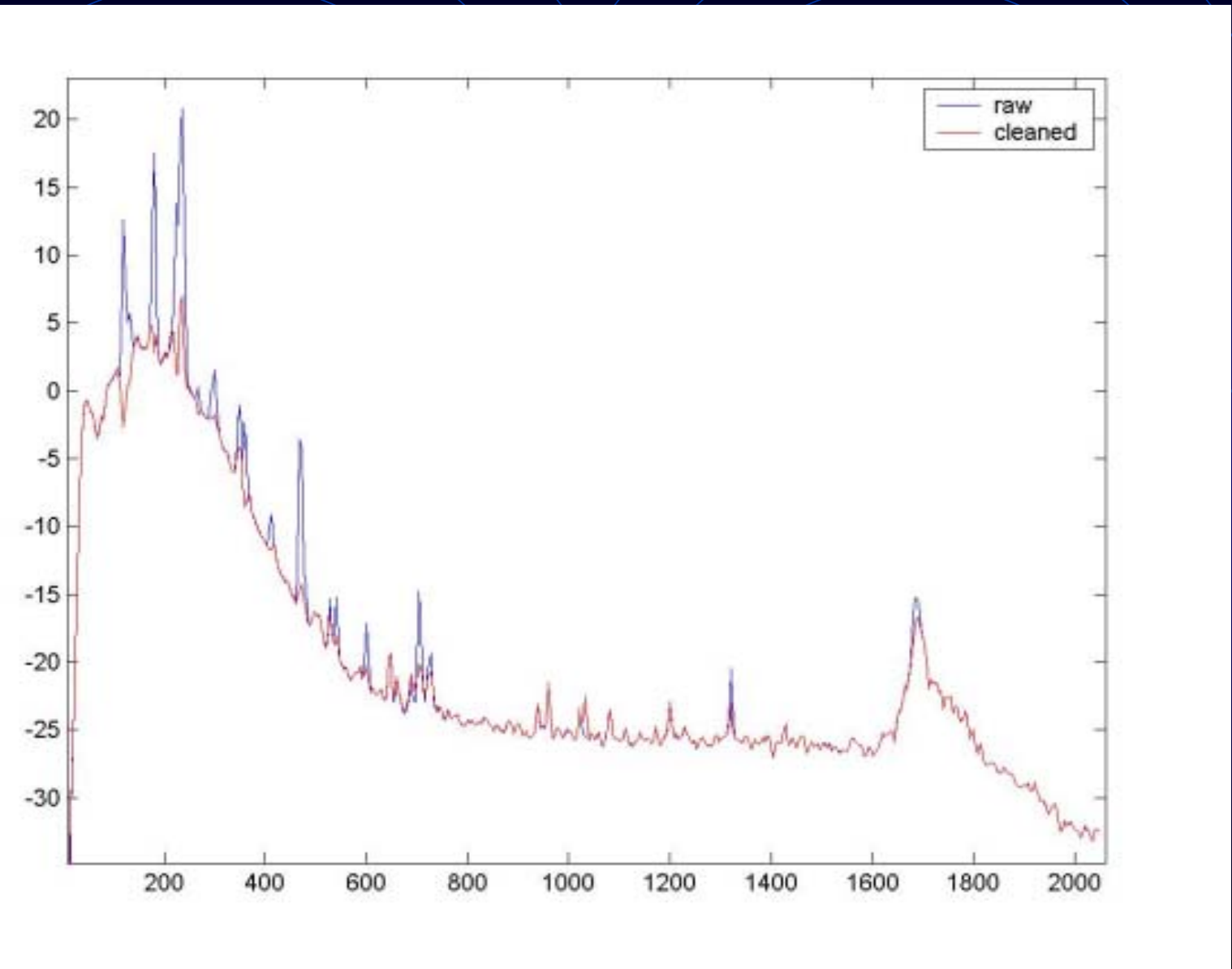
Not over yet ...

- The main contamination comes not from background noise but from nearby lines!
- Remove all other lines except one
- Estimate that line again
- Do the same for all lines
- Iterate

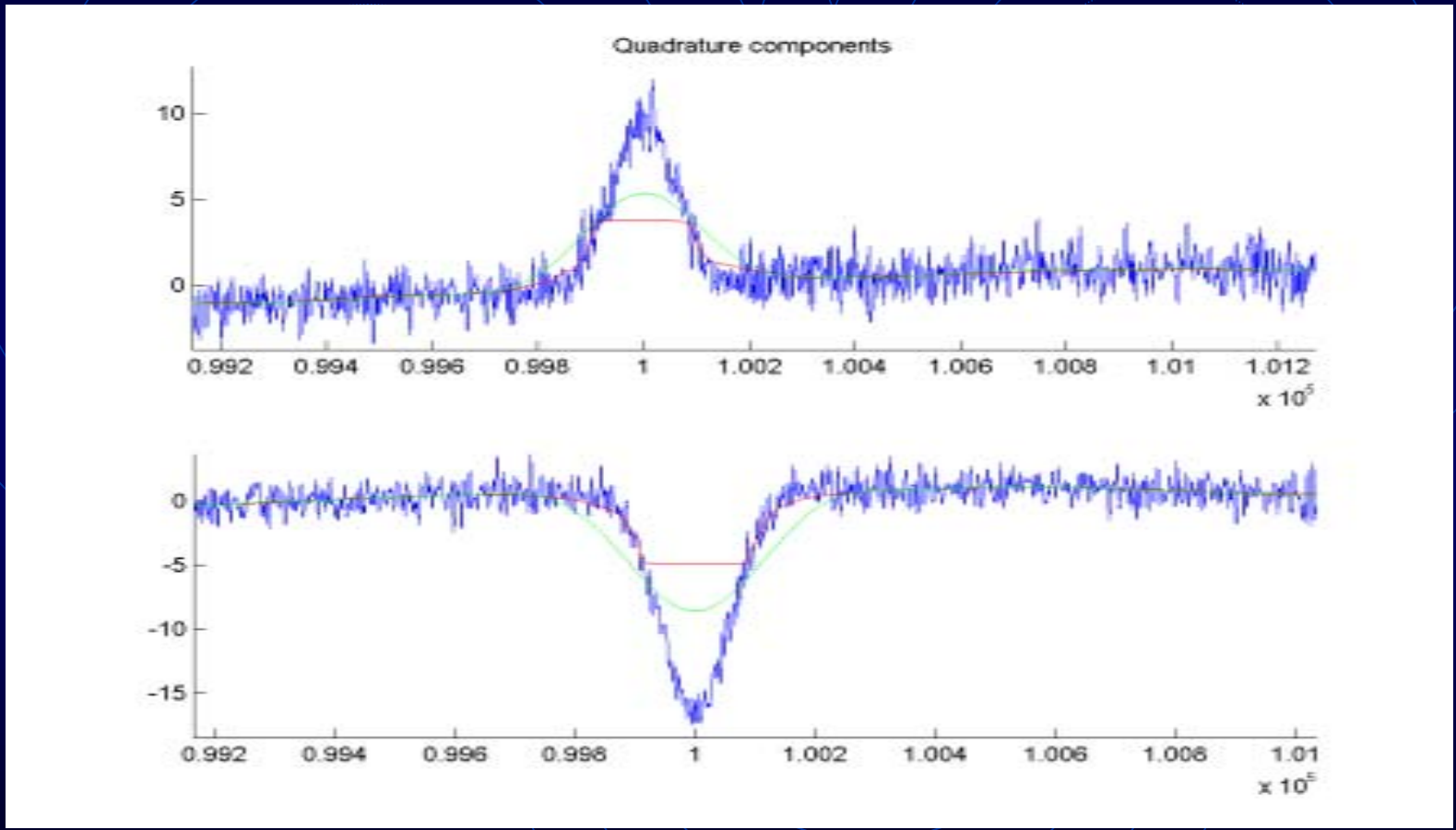
Main problem

- Finding the median of a set involves sorting which is computationally expensive
- But getting a *running* median is much easier since most of the points are already sorted
- C code for a running median written *(Mohanty 2001)*
- Reduces O(Nm^2) tp O(Nm^0.5)

Cleaned data



Effect of transient



Cleaned data; Periodogram