



Tools for Detector Commissioning

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New Paradigm: The Control Room

- most prototype efforts used oscilloscopes, spectrum analyzers, strip-chart recorders
- quantity and character of data rule this out for LIGO
- alternative approach enabled by Data Acquisition System
- realized by ilog, DV, GDS, and DMT



Interferometer Log (ilog)

- need to share across users, sites/campuses, media
- replacement for Lab Notebook
 - » text, tables, html
 - » embedded graphics
 - » links
 - » scanned material when necessary
- vicarious participation, distributed contributions

13:40:52

04/04/2000

View
External
Object

End of 24 Hour Engineering Data Run at 12:00 Local time.

Alignment settings in attached table

- [stan](#) ([http://](#) <-- contains reference url for this entry.)

15:13:37

04/04/2000

View
External
Object

Opened Y Arm to check realignment of ITMy performed about two weeks ago.

Conclusion: It appears that the realignment was successful. The Y arm could be aligned using only about 25% of the range of the ASC Bias input.

The alignment settings are tabulated in the attached table.

- [stan](#) ([http://](#) <-- contains reference url for this entry.)

2k, ITMy

16:10:03

04/04/2000

At 10:35 PDT I turned off the office area air handler.
 At 11:05 PDT I turned the office area air handler back on.
 At about 11:30 I turned off the Kobelco purge air compressor and the Culligan water conditioner pumps.
 At 11:43 I turned the office area air handler off.
 The office area air handler, purge air compressor and water conditioner were left off for the few remaining minutes of the run.

The office area air handler is responsible for peaks at about 21, 29 (other sources also) 32, 35, 42 Hz and other smaller peaks, as expected (see "frequencies of some corner station sources", DCC and CDS web page under PEM).

- [robert](#) ([http://](#) <-- contains reference url for this entry.)

18:01:16

04/04/2000

Installed support tubes in WBSC 9 (X end), supported by jib cranes (H. Radkins, C. Gray, M. Landry, G. Moreno, P. Shawhan)

- [ljones](#) ([http://](#) <-- contains reference url for this entry.)

SEI, VE

18:51:17

04/04/2000

View
External
Object

From last night's 24hr run, here is a plot of the control signal as a function of time, showing a nice tidal effect. The data has been adjusted so as to compensate for the loss of locks.

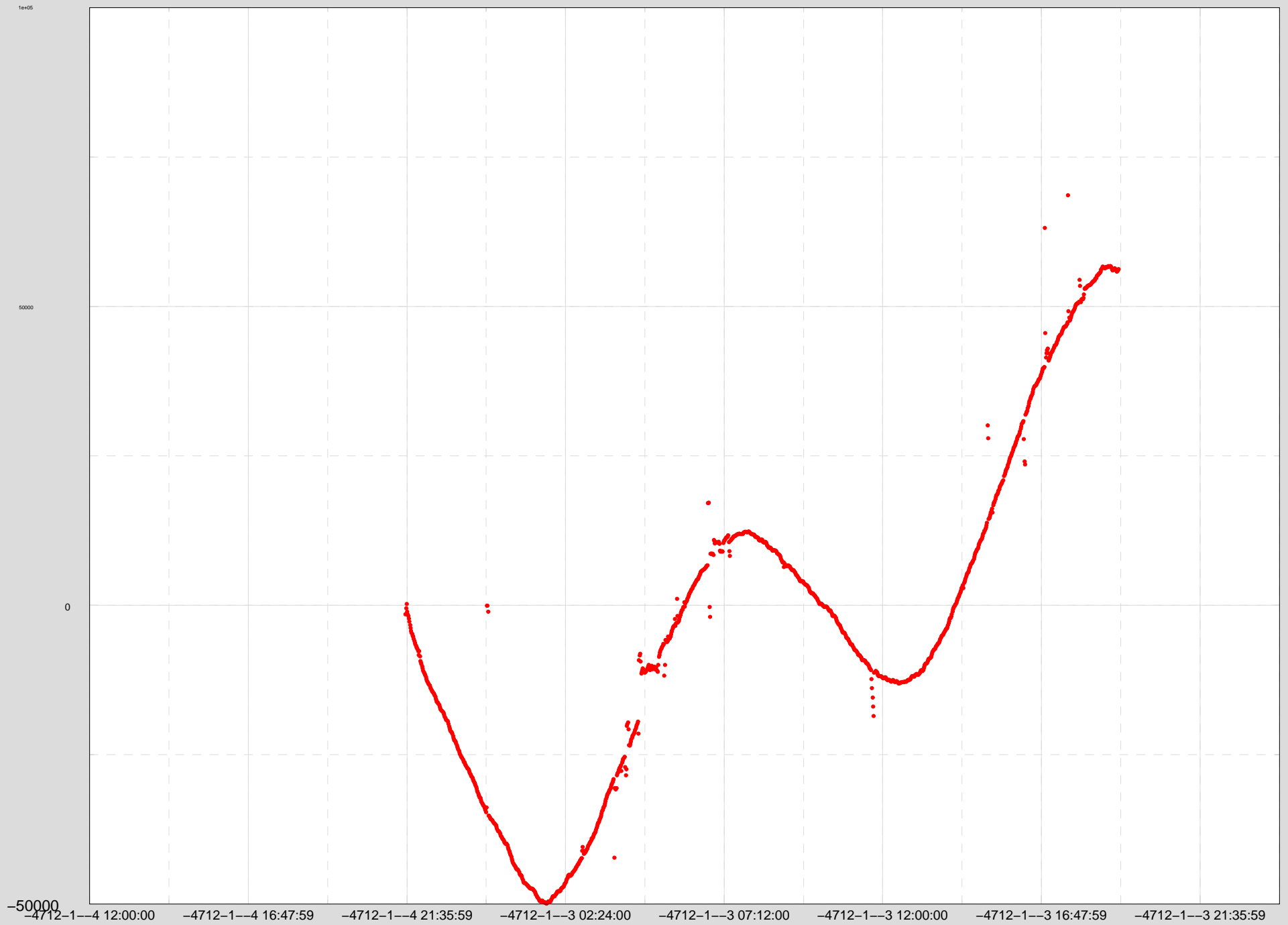
- [luca](#) ([http://](#) <-- contains reference url for this entry.)

tides

• MEAN

Trend Data from 00-4-3-16-0-10 to 00-4-4-21-59-25

Trend Ch 1: H2:LSC-AS_I_TEMP



14:13:12

04/09/2000

View
External
Object

Opened the X Arm about 14:00

Goal was to find the resonances of the ETMx and measure the Q's of the modes.

To drive at these high frequencies, we had to use a signal generator in the x-mid station, connected to the LSC input of the ETM

To measure observe the excitation of the modes, we fed the arm cavity servo signal to a lock in amplifier. The reference for the lockin was a second signal generator set 1-4 Hz away from the resonance; the time constant of the lockin was set to 30 ms so that it could respond well at the beat frequency. The output of the lockin was temporarily fed into the daq system as H2:LSC-AS_I_TEMP. The mass was excited by enabling the LSC test input briefly (2-100 seconds depending on mode) and then the input was disabled to let the mode ringdown.

Three modes were measured: the butterfly mode (6639.0 Hz), the drumhead mode (9254.0 Hz) and the first longitudinal mode 14374 Hz)

The attached figure shows ringdowns of these modes. The first large ring down is the 14.374 kHz mode. The secong large ringdown is the 6.639 kHz mode Both show amplitude decay times of about 2 1/2 minutes corresponding to Q's of roughly 8e6 and 3e6. The last ringdown in the figure is the 9.2 kHz mode with a decay time of 2-3 seconds. This would correspond to a Q ~ 1e5, which is very low.

We repeated the ringdowns of the 9.2kHz mode with various of the suspension damping loops disabled to see if somehow the local damping might be affecting the Q, but there were no significant changes in the ringdown time.

Better fits to the data to get more accurate Q's will be forthcoming.

We closed the gate valves about 20:00.

(D. Gustafson, N. Mavalvala, S. Whitcomb

- [stan](#) ([http://](#) <-- contains reference url for this entry.)

16:41:33 The curve-fit parameters for the ringdowns measured of the ETMx
04/10/2000 internal modes are as follows:

fo(kHz) Q A1(time)

14.374 7.3E6 2.70 min

6.639 2.8E6 2.20 min

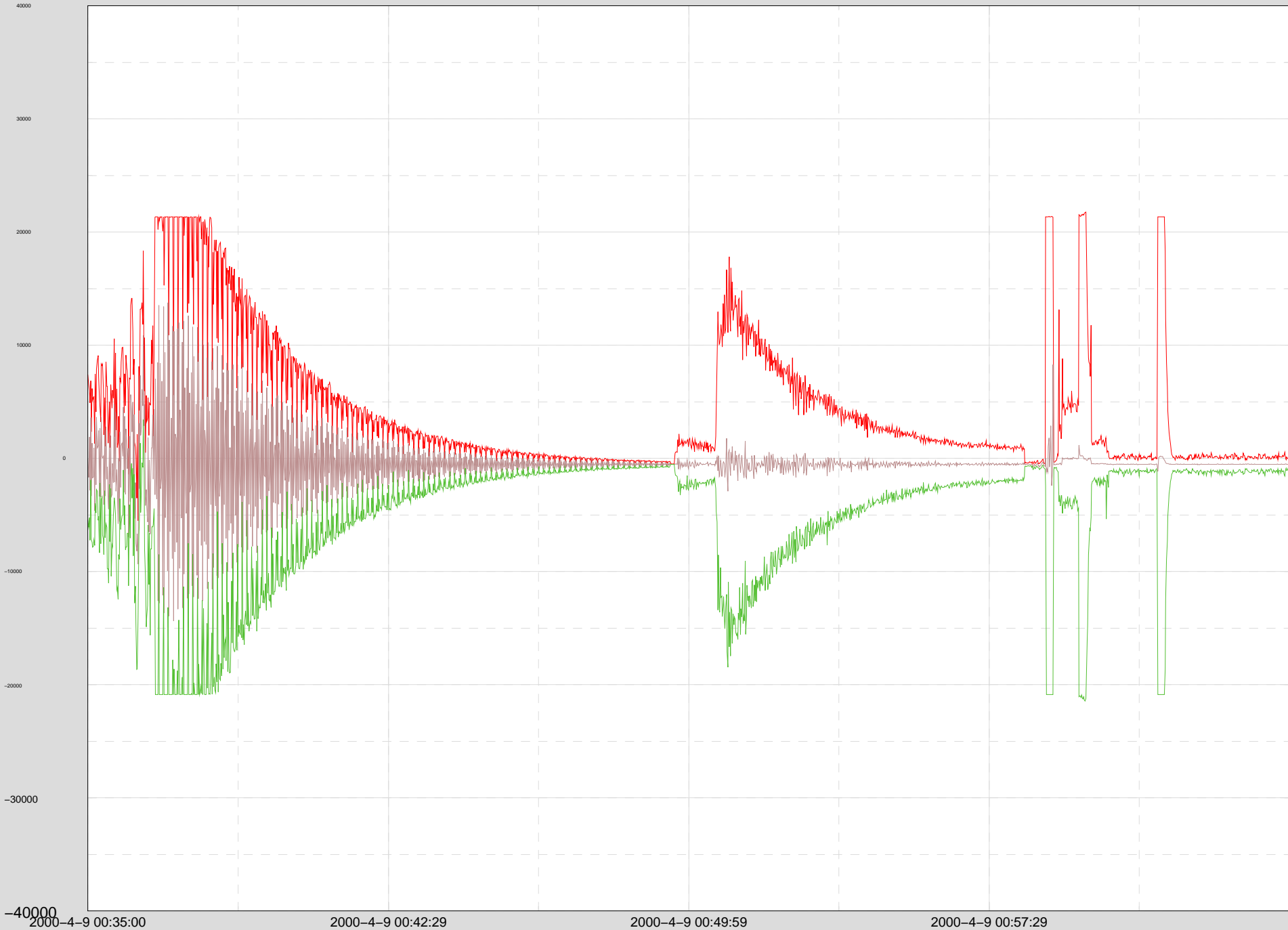
9.254 7.8E4 2.70 sec

- [betsy](#) ([http://](#) <-- contains reference url for this entry.)

Trend Data from 00-4-9-0-35-0 to 00-4-9-1-4-59

MAX
MEAN
MIN

Trend Ch 1: H2:LSC-AS_I_TEMP





Functions of Control Room Tools

- Assist the operators in the control room and in the experimental areas to successfully run the machine
- Establish & automate commissioning/diagnostics procedures.
- Provide immediate answers:
 - » What are the quality of the GW data written to disk?
 - » Are all of the subsystems working properly?
- Give assistance to:
 - » learn about the behavior of the instrument,
 - » classify abnormal environmental events,
 - » identify the exact machine state,
 - » correlate the signals of different sensors and,
- ultimately, reduce the large amount of measured data to a set of relevant and comprehensible statistical quantities.

Design Principles

- **Scalable**

- can grow with users
- can grow with experience
- incrementally useful

- **Powerful infrastructure**

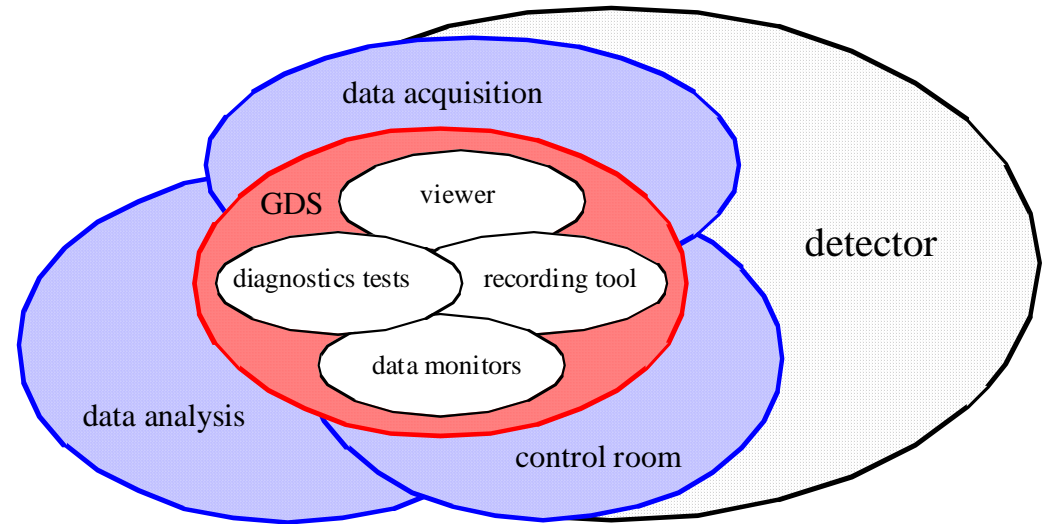
- access to all data in ‘real time’
- processing power to ingest, evaluate, reduce all data in ‘real time’
- analysis tools to give ‘HP-box’ versatility and ease-of-use

- **Expandable**

- aid in creating reduced datasets
- closed-loop stimulus-response
- system identification/adaptive control

G000109-00-R

- element in GW data analysis





Emulation of the Prototype Lab: Data Viewer

- need screen shot of DV
- time series of any (collection of) channels in system
 - » samples vs. ADC counts --- real hardware check
- trends
 - » seconds, minutes
- real-time or near history
- data made available through web access ('JDClient')



Global Diagnostics System (GDS)

- GDS Passive tools
 - » focussed on frequency domain characterization
- GDS Stimulus/Response
 - » function generators, real and virtual
- accesses/drives analog and digital control systems
 - » laser, suspensions, environmental monitor
 - » length, alignment
- on-line (real-time) and off-line use



Data Monitor Tool (DMT)

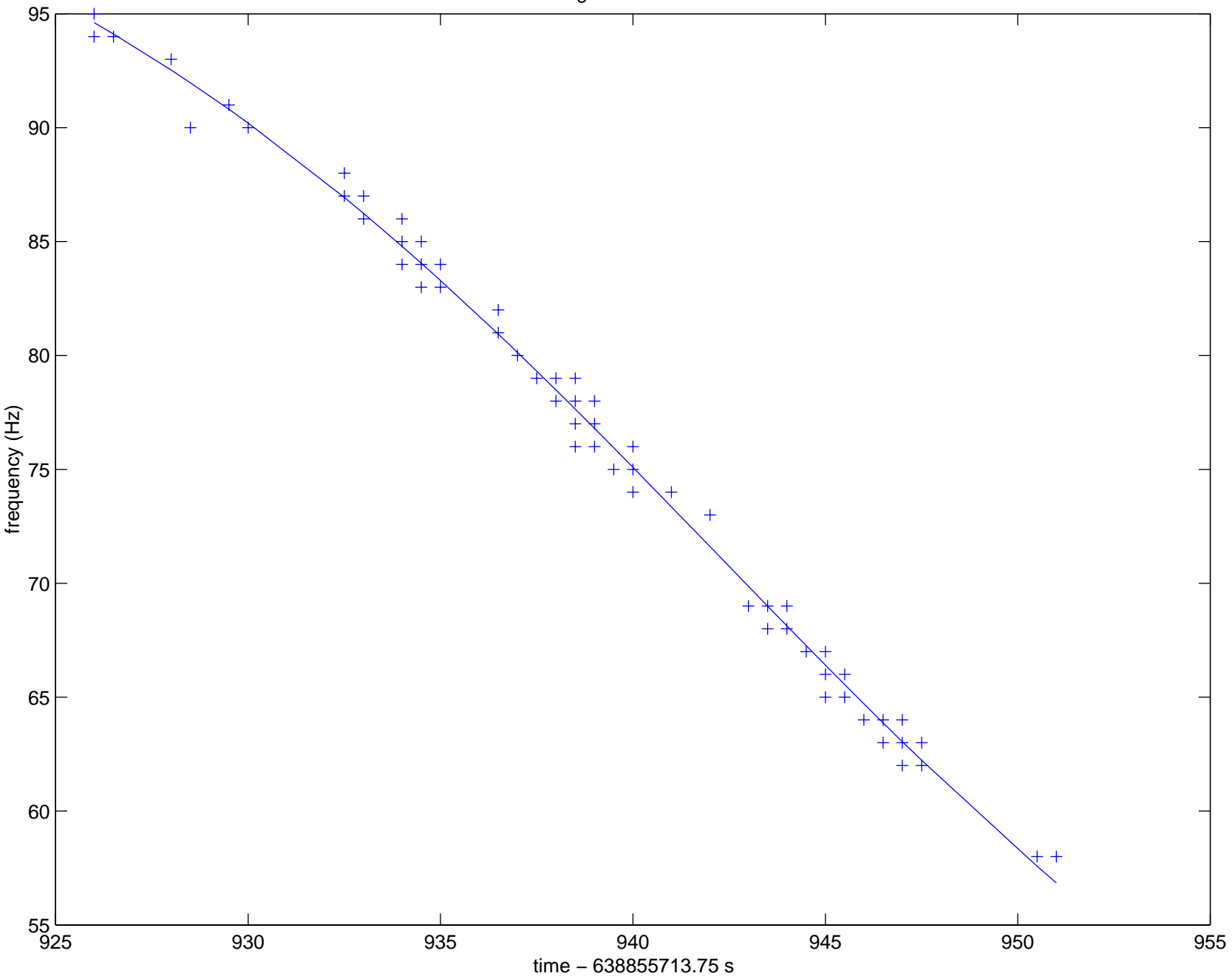
- Very flexible trigger system
 - » designed to give the look and feel of a sports car, not a freight train
 - » good feedback to operator
 - » allowed to take significant computation
 - » data input/output such that interfaces and re-use of output easy
- straddles Data Analysis/Diagnostics frontier
- can handle all of the data all of the time
- does present data archiving ('RDS')
- applications starting to be developed and regularly used
 - » stuck bit sensing
 - » earthquake monitor



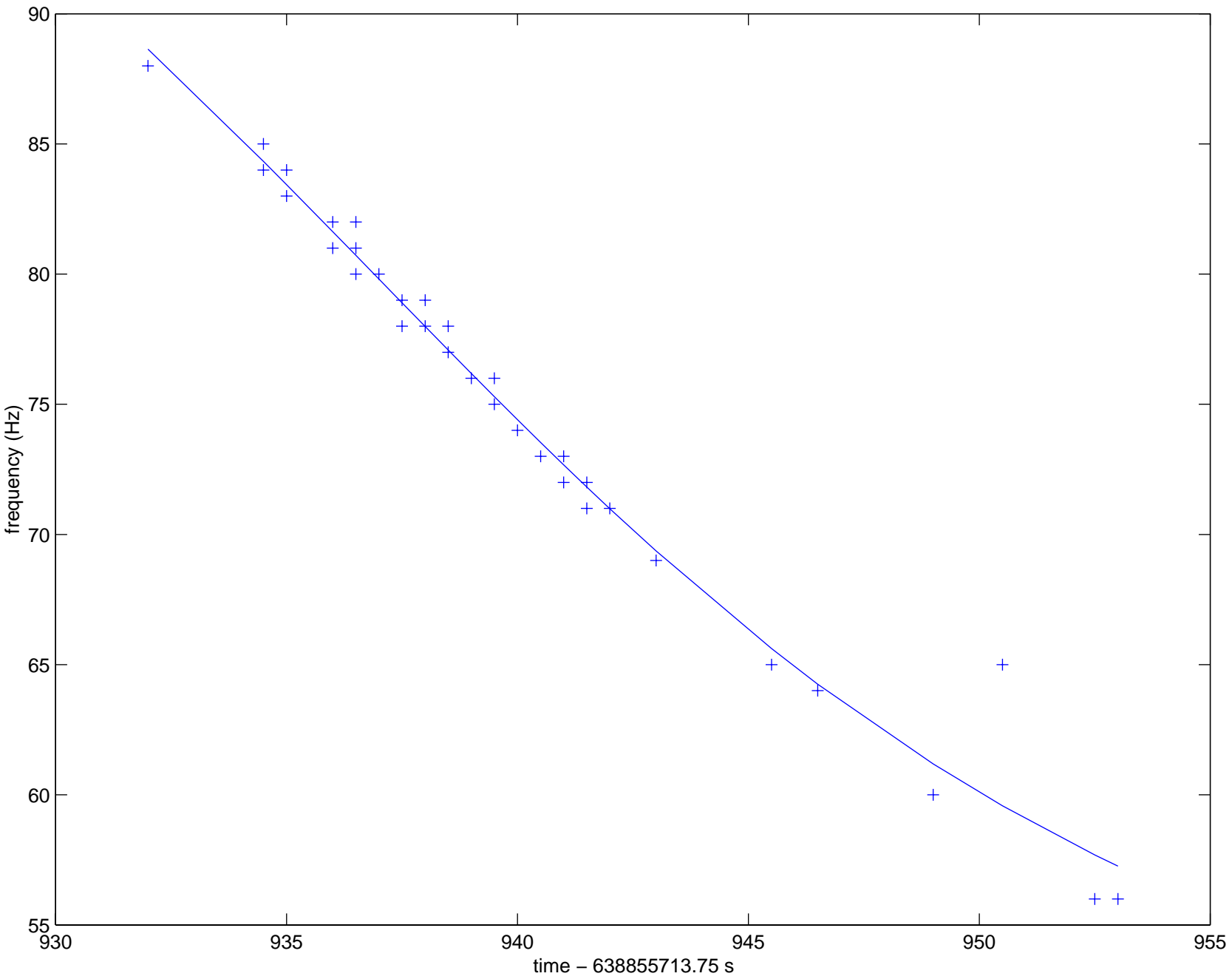
Frames and home-built software

- distinction from Data Analysis fading...
- use of RDS-written frames in Matlab purpose-written code
- search for information in time-frequency plots
- ...airplane doppler shifts?

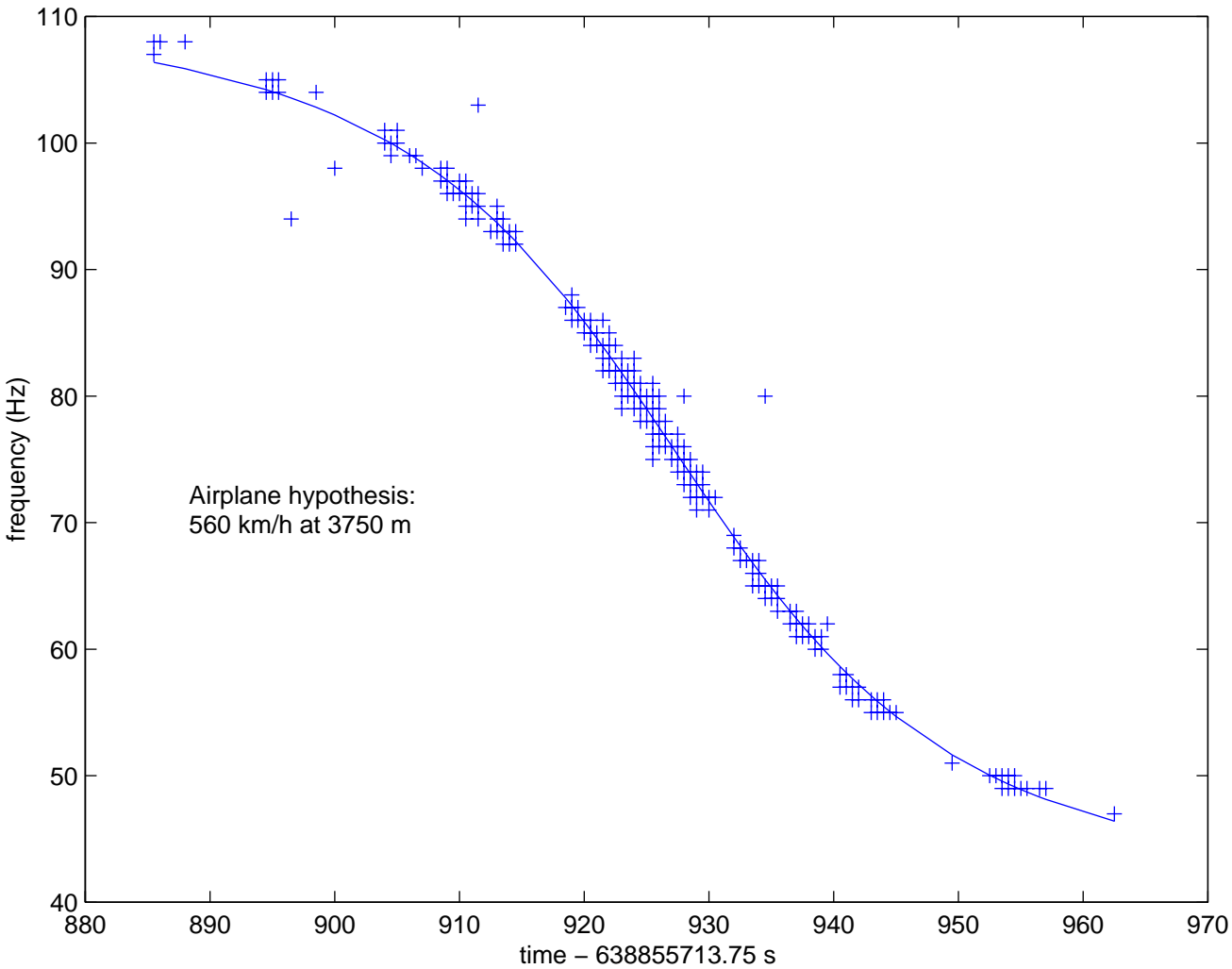
Control Signal - LSC AS I TEMP



LVEA SEISZ



MX SEISX





Tools

- allow us to deal with the
 - » quantity of data
 - » number of channels
 - » physical size
- - of LIGO
- allow a number of skilled hands and minds to work in parallel
- qualitatively different from, and better than, our previous experience