

# LINE REMOVAL TECHNIQUES

UF.

COLDWELL

KLIMENKO

WHITING.

ANU.

CHARLTON

SCOTT

WHICH LINES ?

- ① 50/60 Hz HARMONICS
- ② VIOLIN RESONANCES.

WHICH TECHNIQUES ?

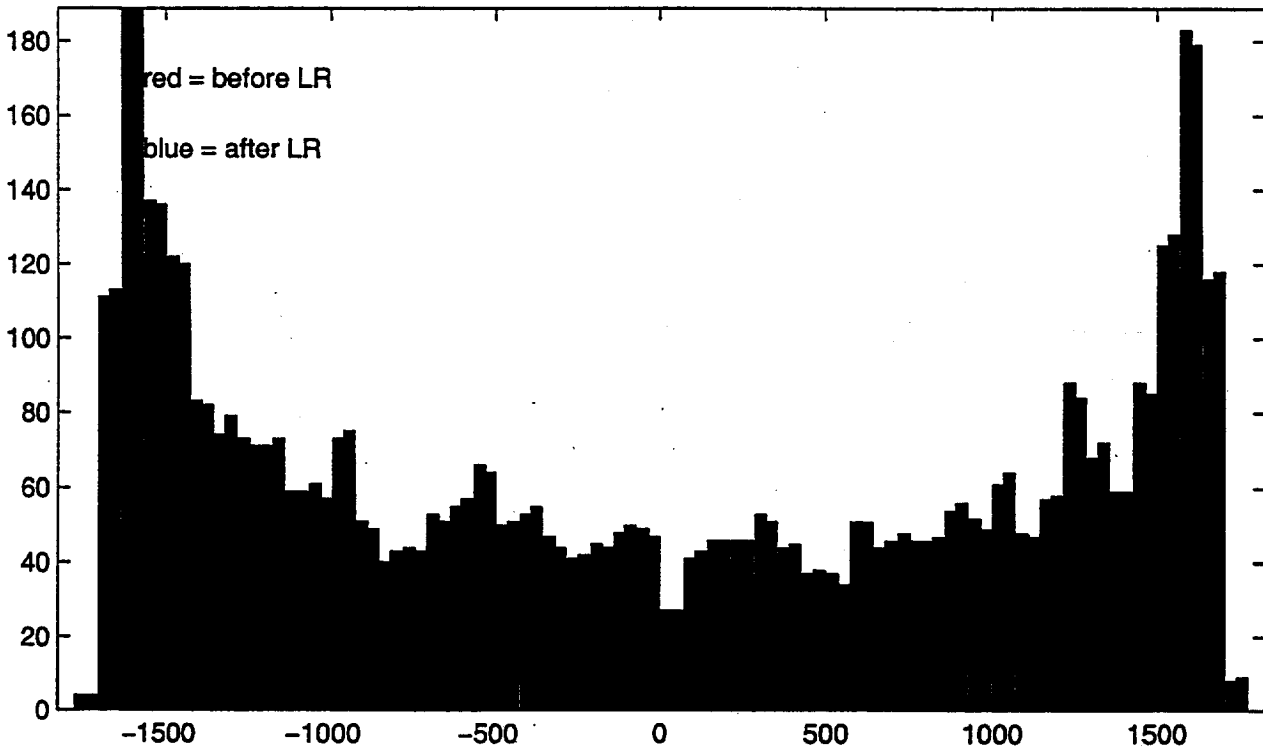
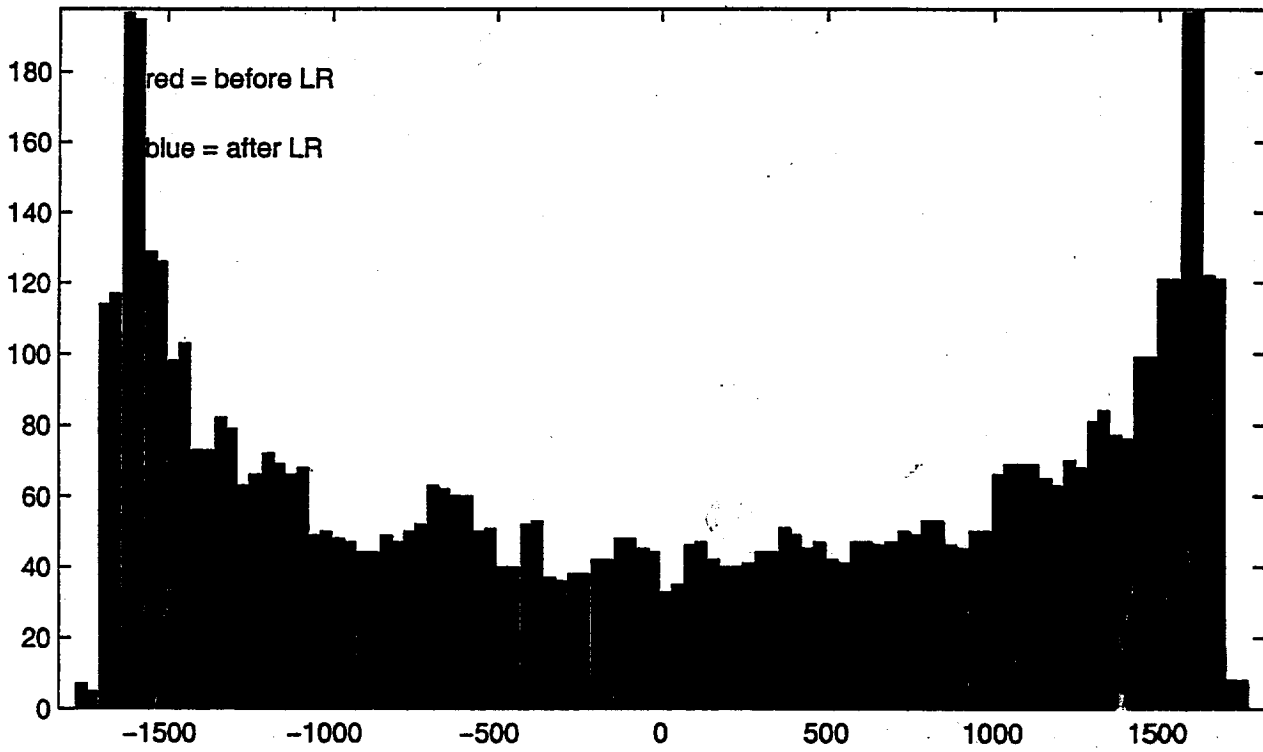
ALLEN & OTTEWILL ① & ②

SCHUTZ & SINTES ①

KLIMENKO ① & ②


FINN & MUKHERJEE ② ( & ① ? )

Histograms at 725.10 Hz ( $f_n=1486$ ) from 13213696 points

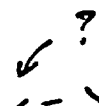


# PROPERTIES.

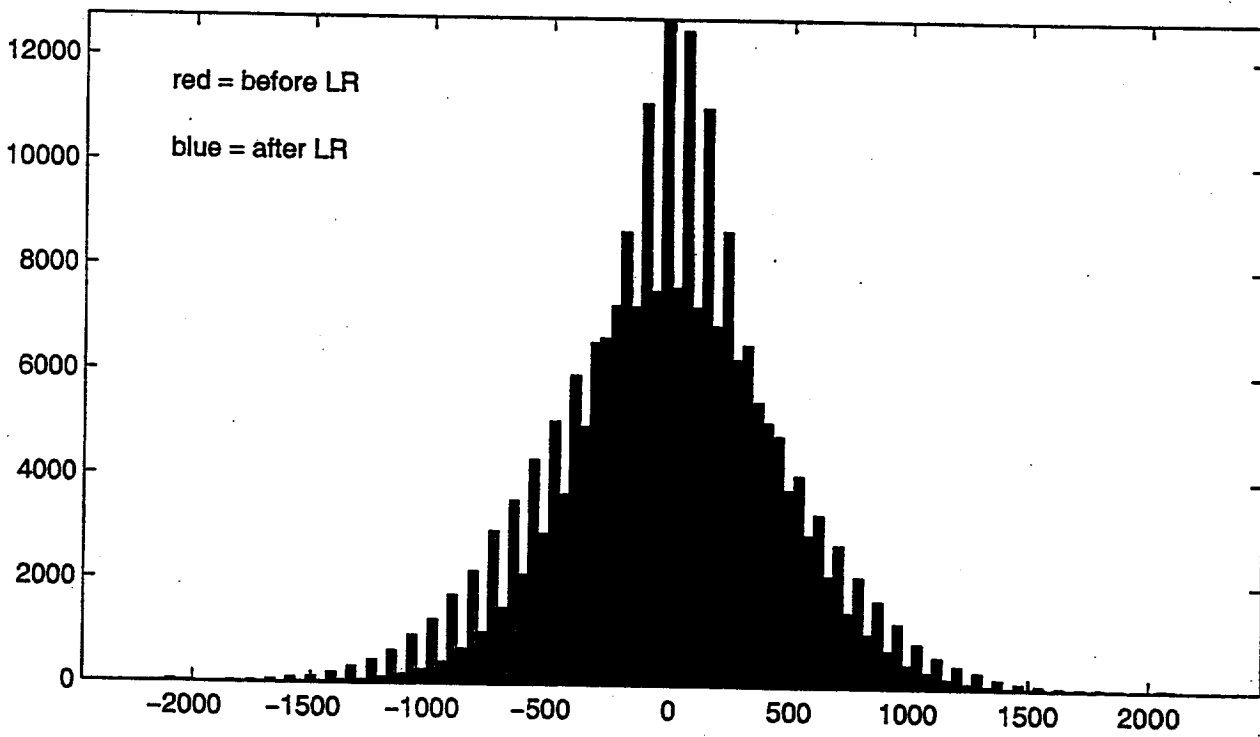
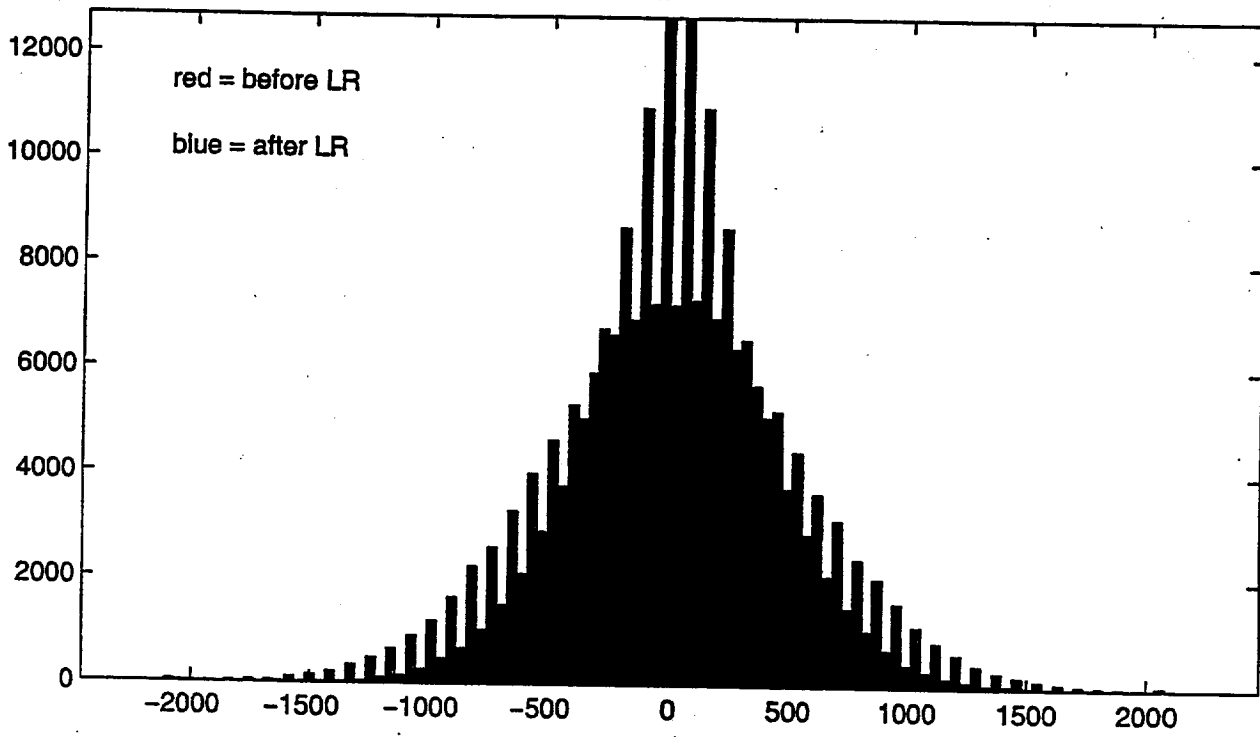
- MAINS HARMONICS

- EXTERNAL AGENT CONTROL
- TIME DEPENDENT (FREQ.)
- COHERENT (AMP & PHASE) 

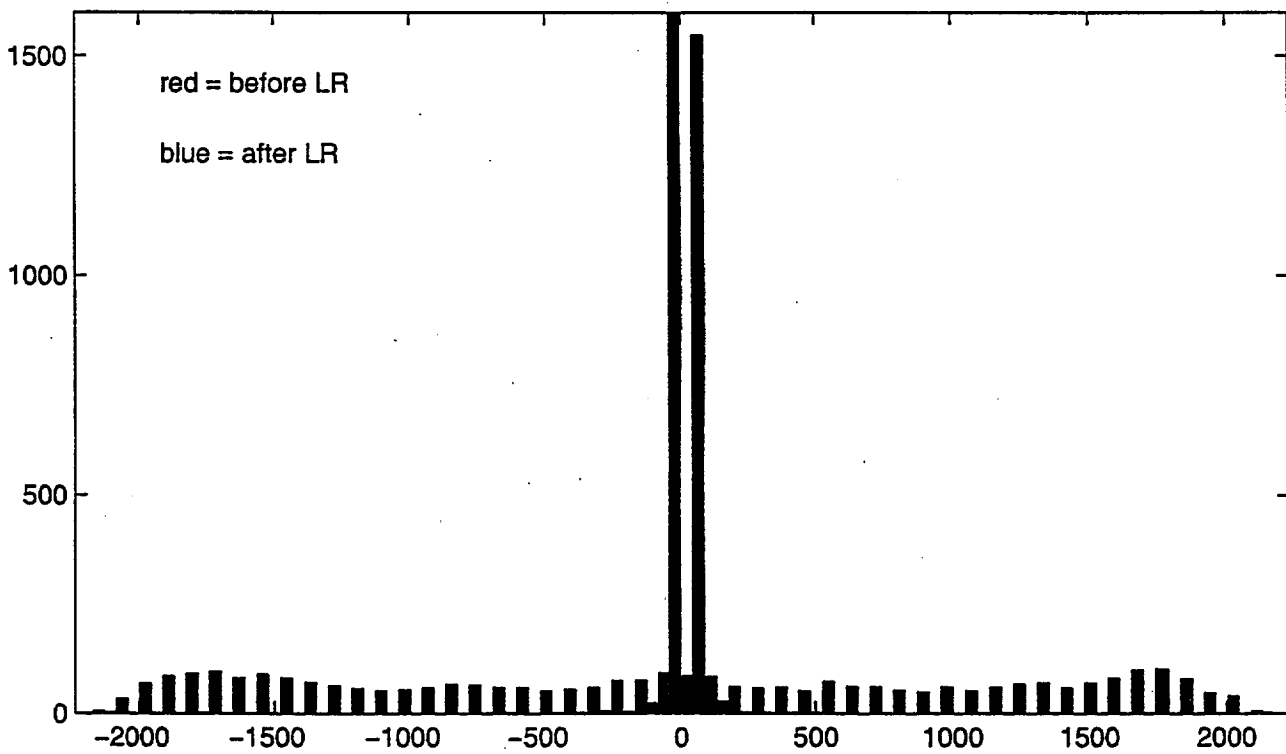
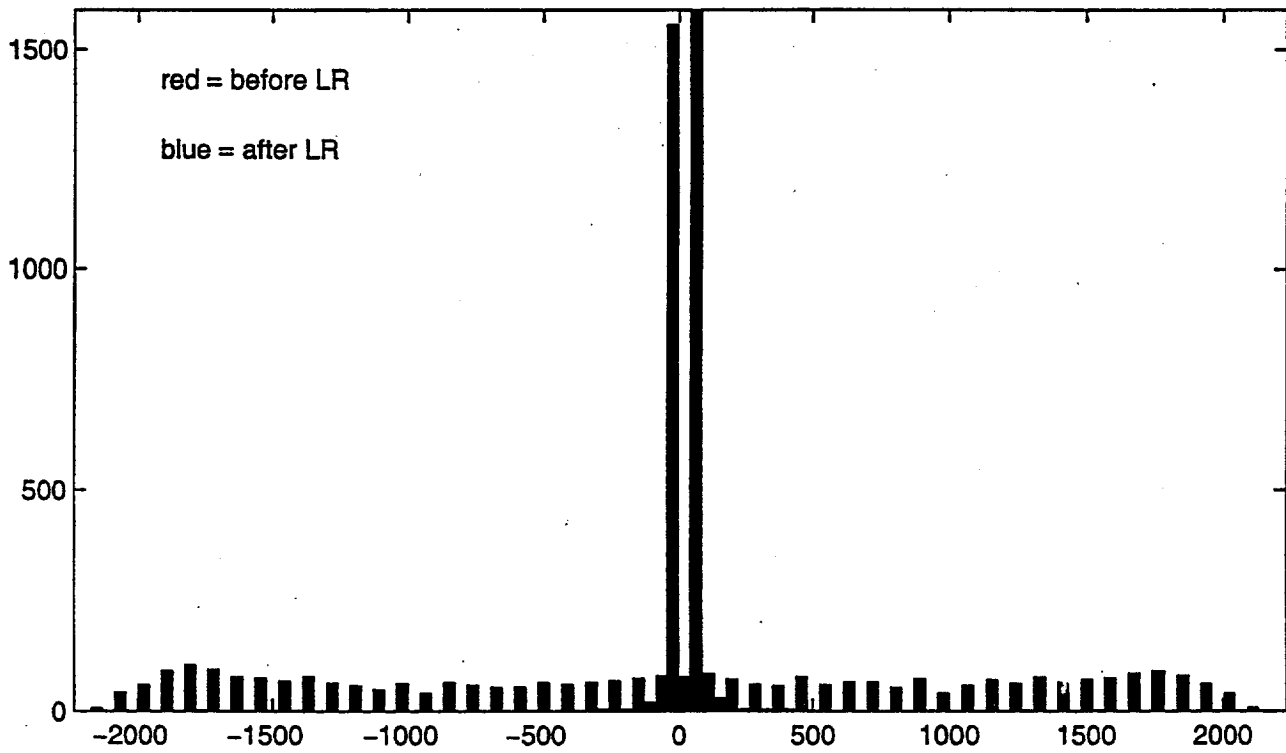
- VIOLIN RESONANCES

- LOCAL PHYSICS CONTROL
- TIME DEPENDENT (FREQ.)
- STOCHASTIC (AMP & PHASE) 

Histograms at 60.23 Hz ( $f_n=51$ ) from 114376000 points



Histograms at 149.90 Hz ( $f_n=308$ ) from 13213696 points

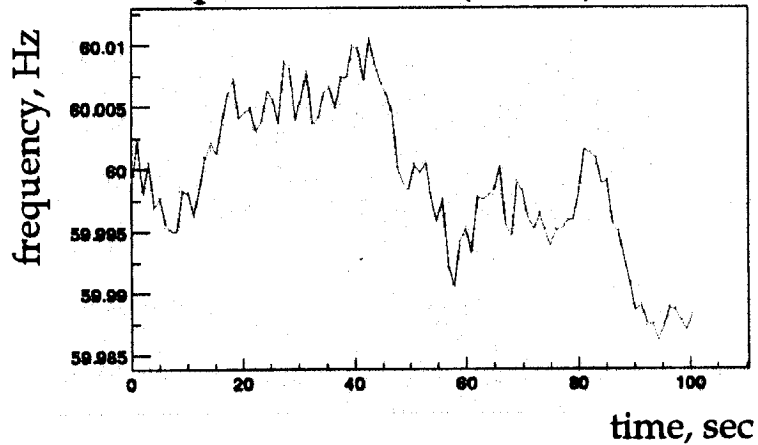




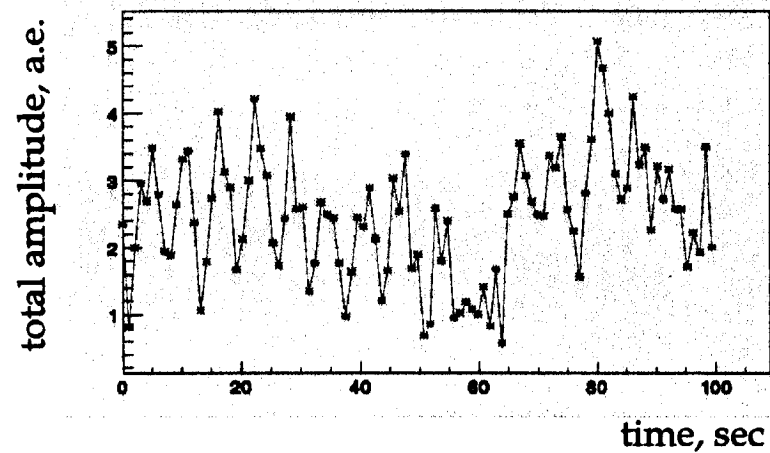
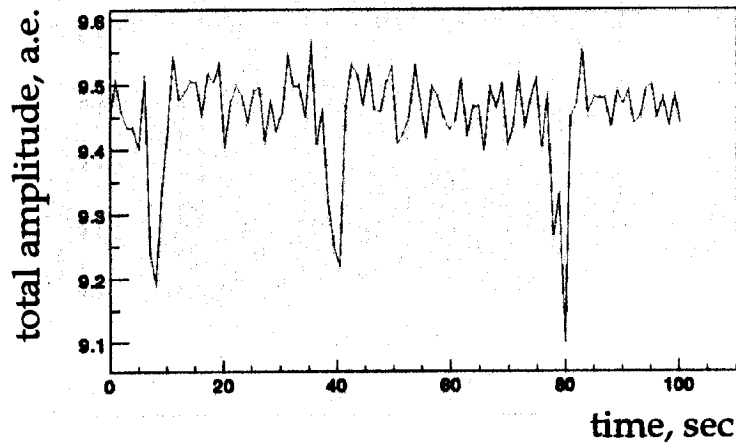
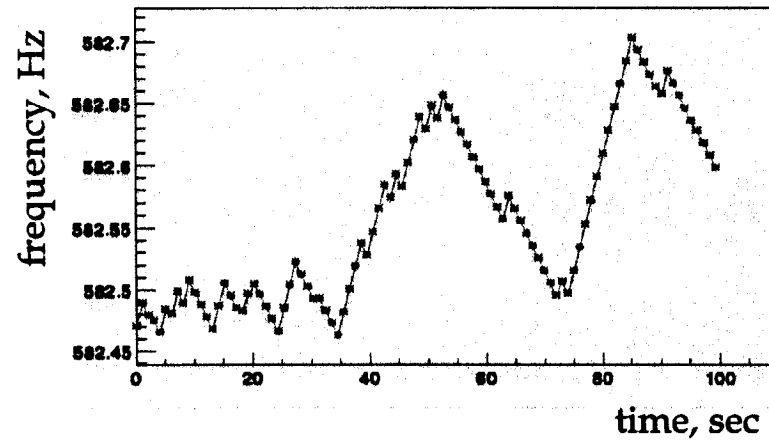
# Monitoring of harmonic lines

- 100 sec stretch of 40m data (20 frames)

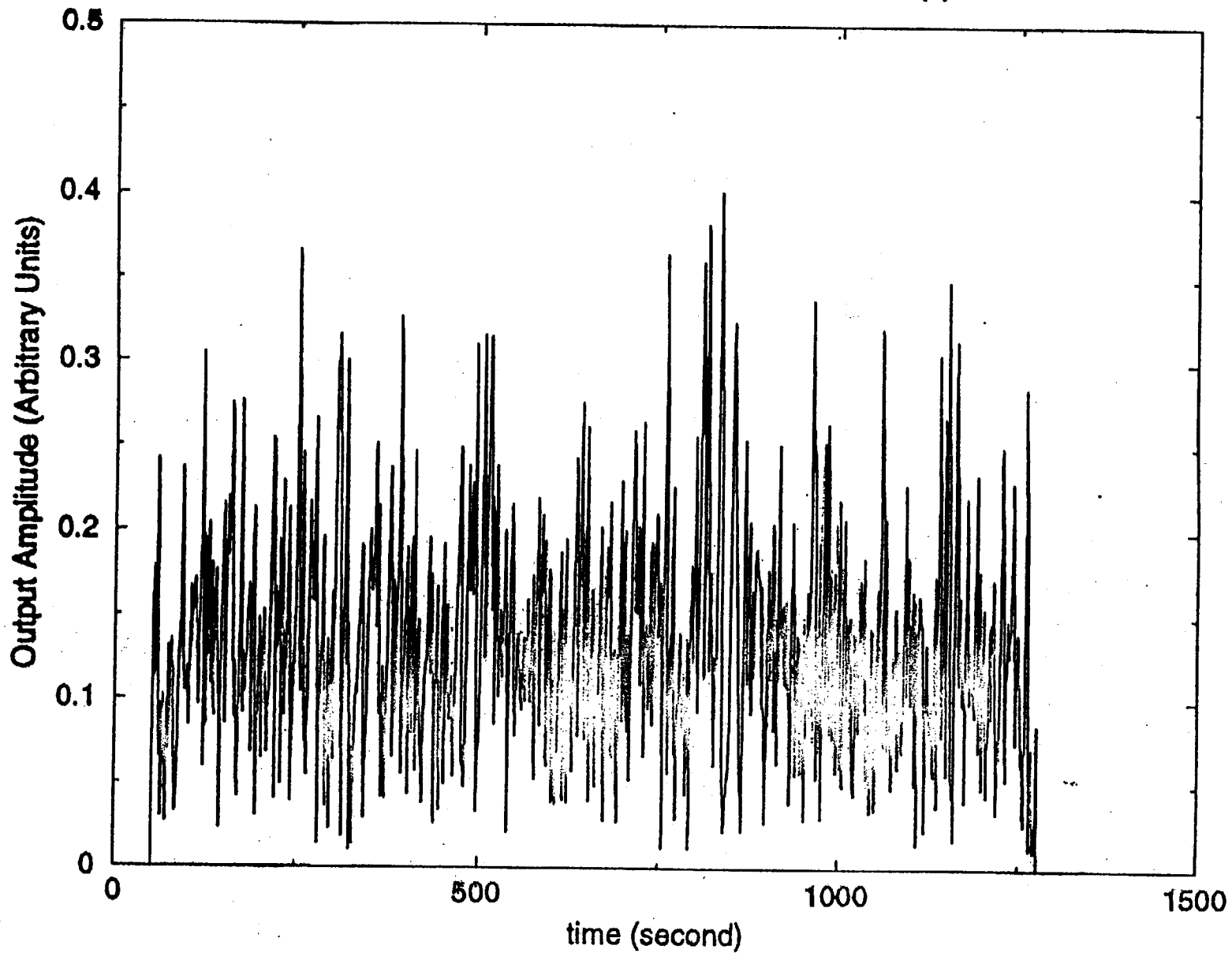
power lines (60Hz)



Violin lines (582.4 Hz)



The amplitude of the best estimation of the  
input of 581.058Hz mode  $x(t)$



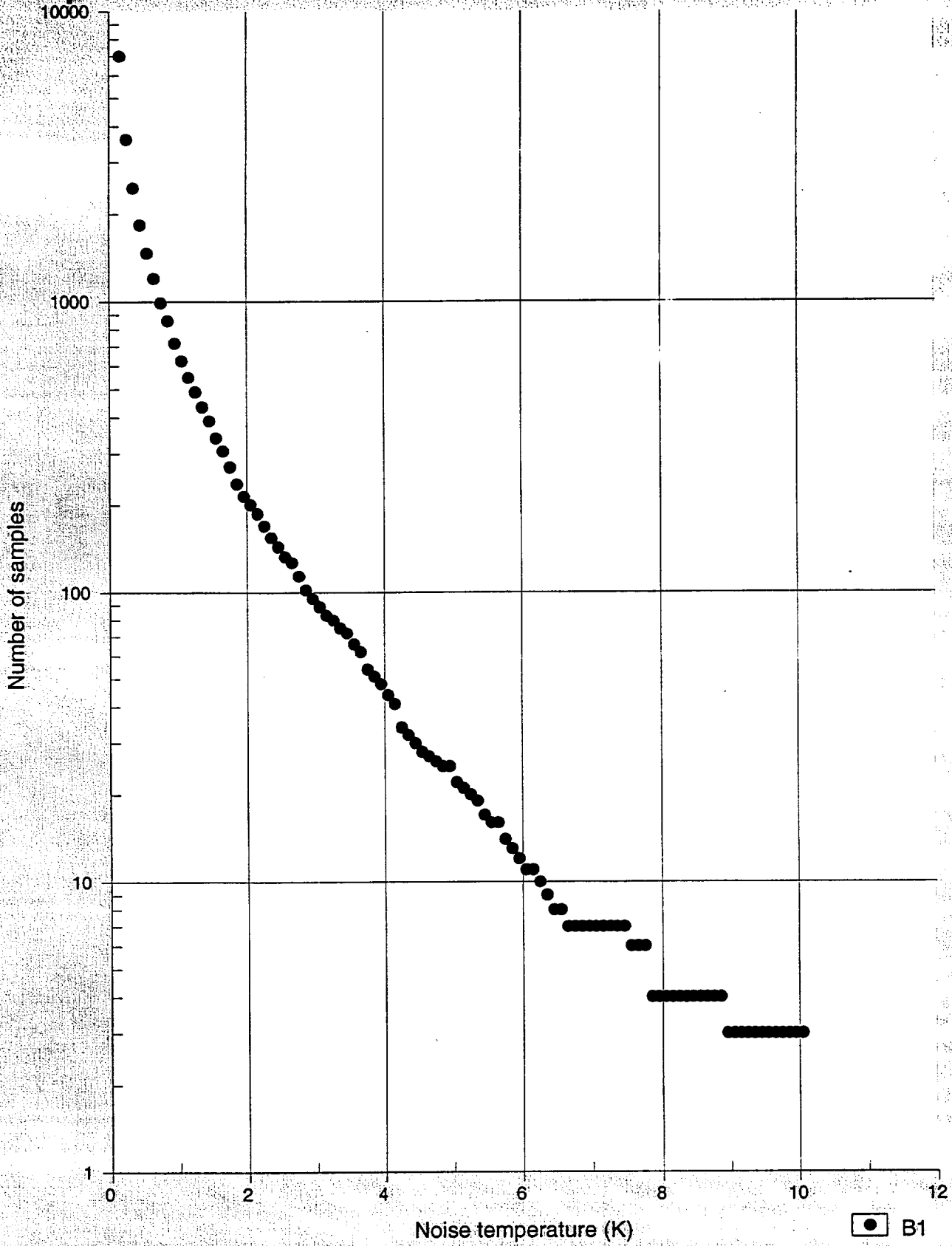
4

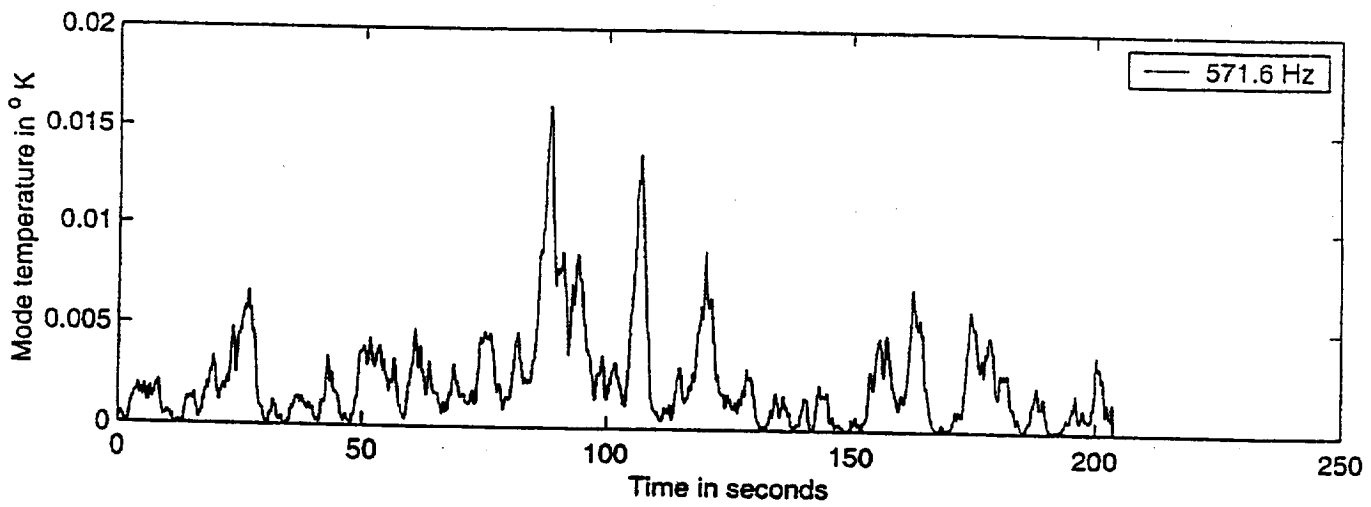
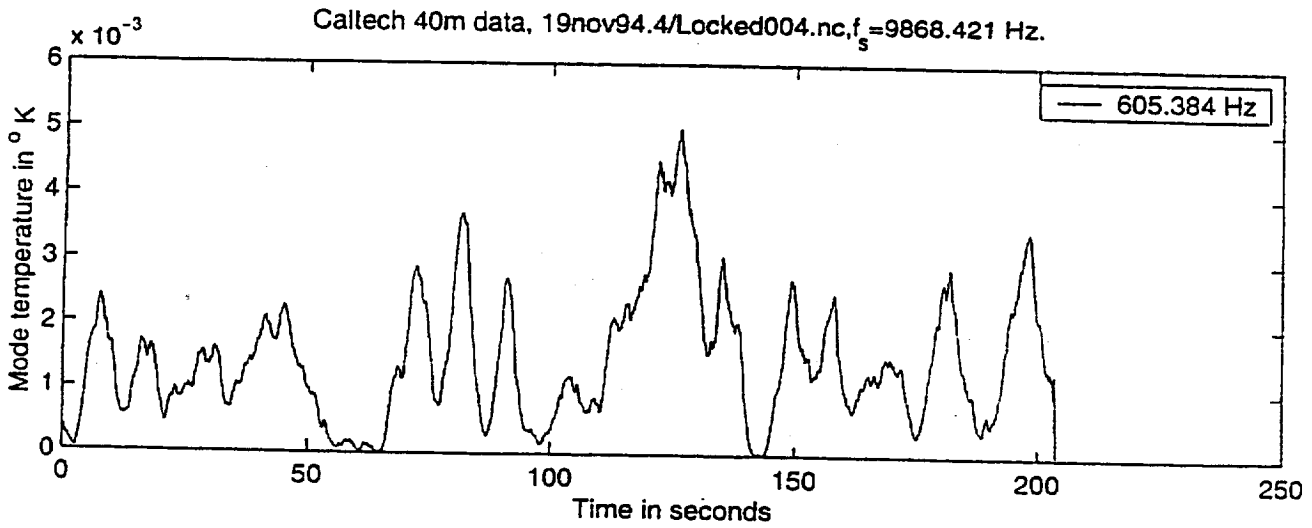
ALLEN.



# Graph

Excess noise from Perth bar (1997)





## STATISTICAL TOOLS

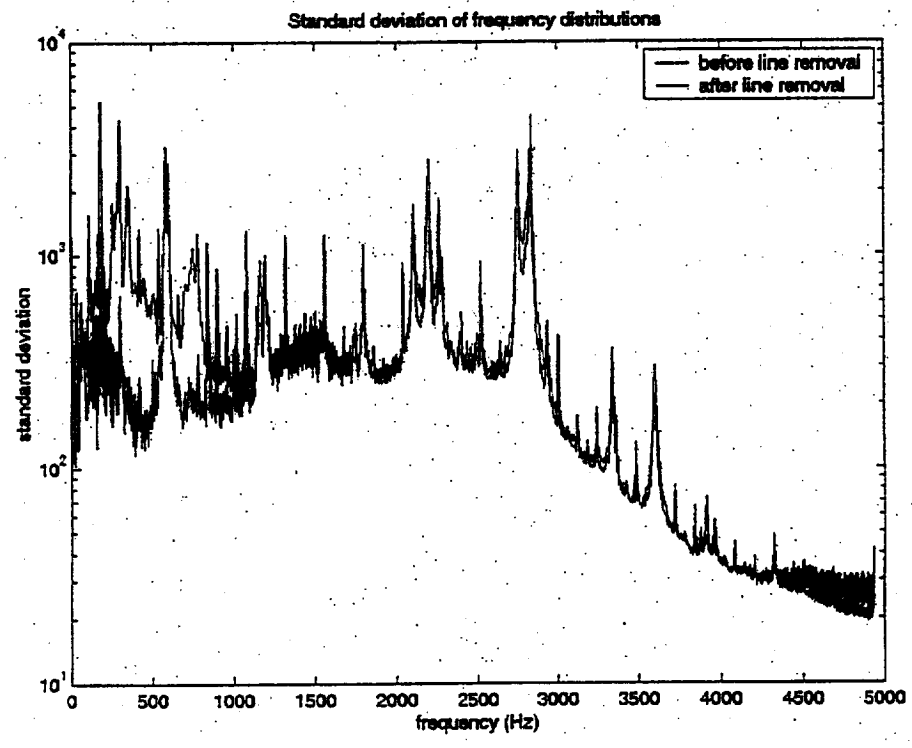
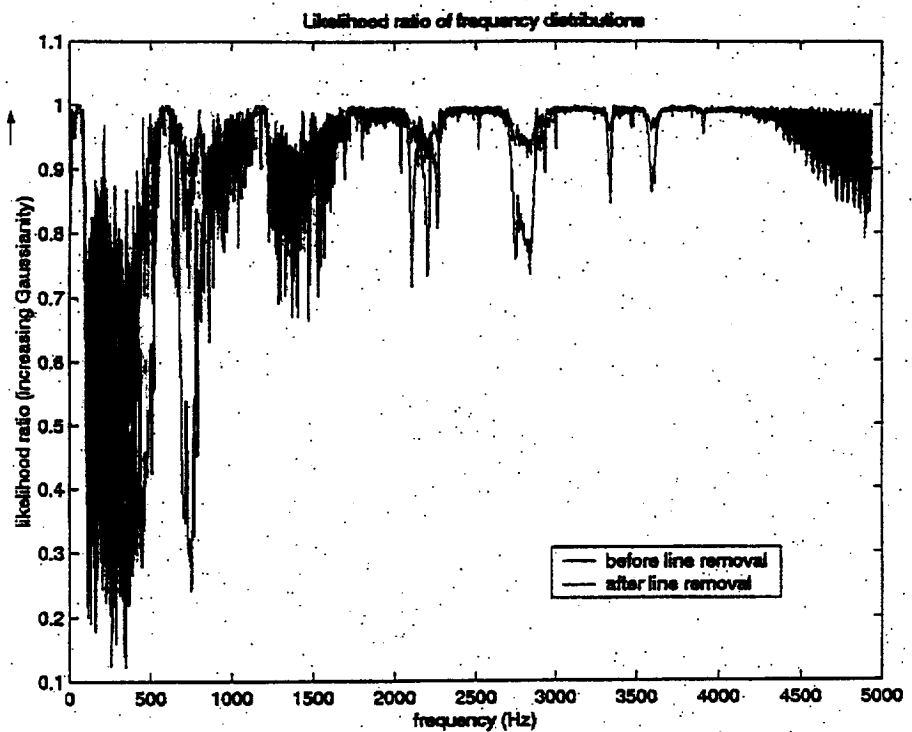
- POWER/VARIANCE RATIO (GONZALEZ)
- LIKELIHOOD RATIO (UF & ANU)
- ROBFIT (COLDWELL)

## FURTHER WORK

- SEPARATELY ESTIMATE  
COHERENT AND STOCHASTIC  
PARTS FOR HARMONICS (INC. PHASE)
- STATISTICAL ANALYSIS OF  
KALMAN FILTER OUTPUT. (MUKHERJEE  
OUTPUT)
- "KALMAN" FILTER FOR HARMONICS (?)
- CHASSANDE-MOTTIN CODE ?

01, 0

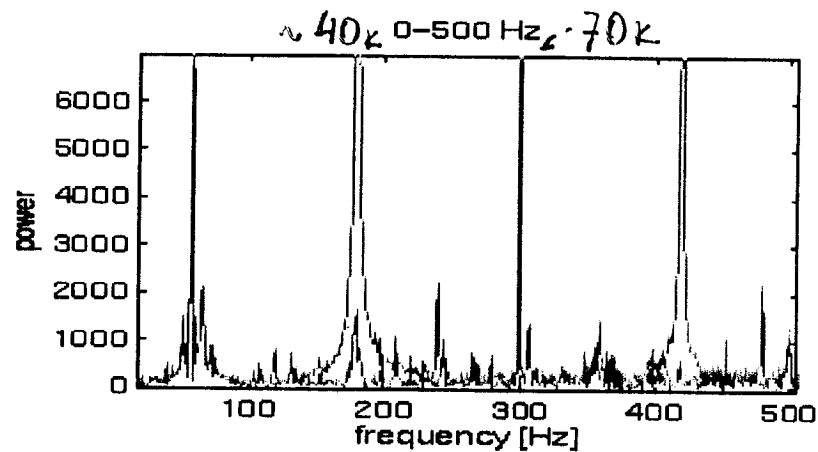
pic 10



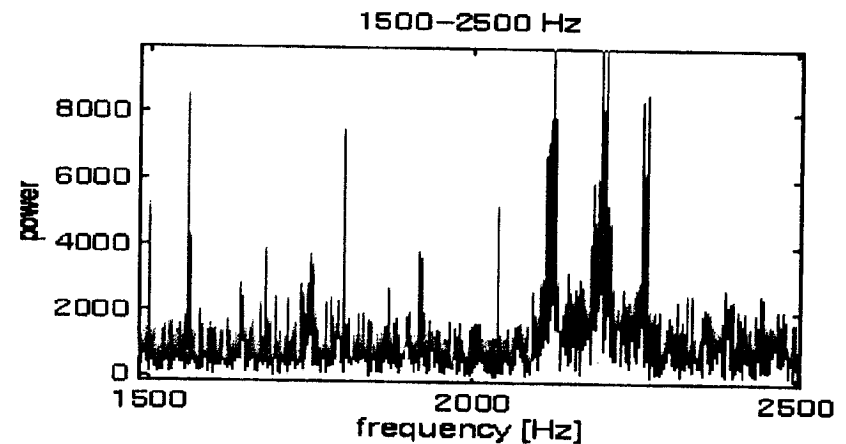
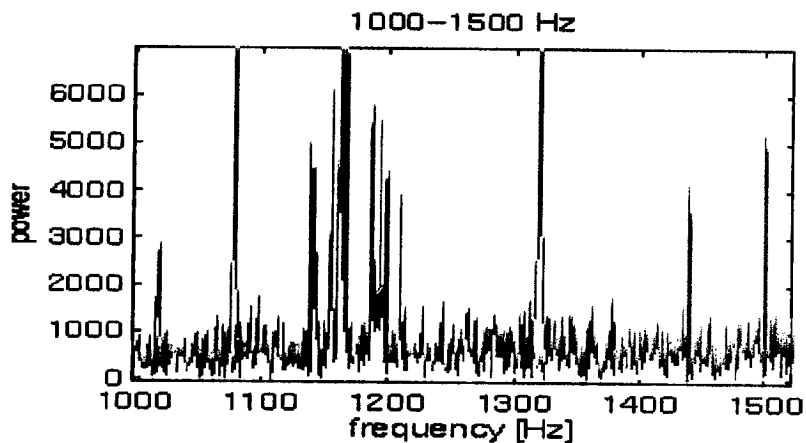
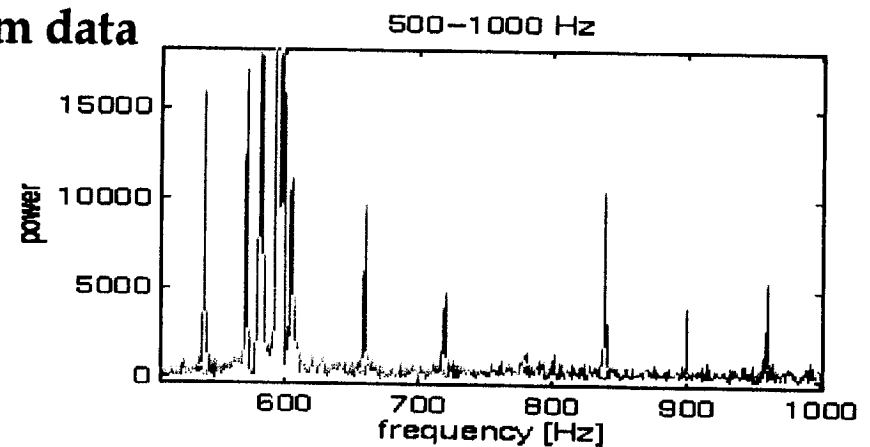


# Power Lines Removal

- Sample of 10000 points, (1sec), blue - data with lines, red - lines removed

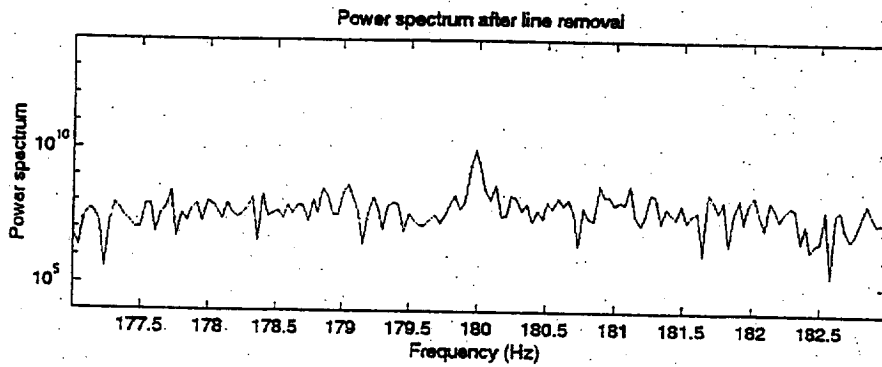
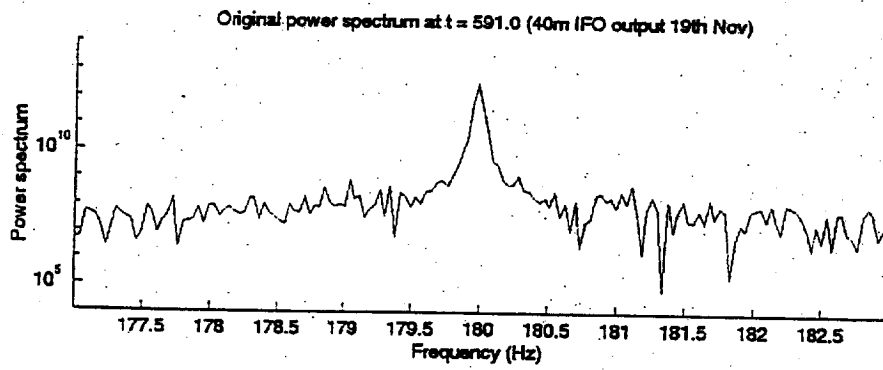
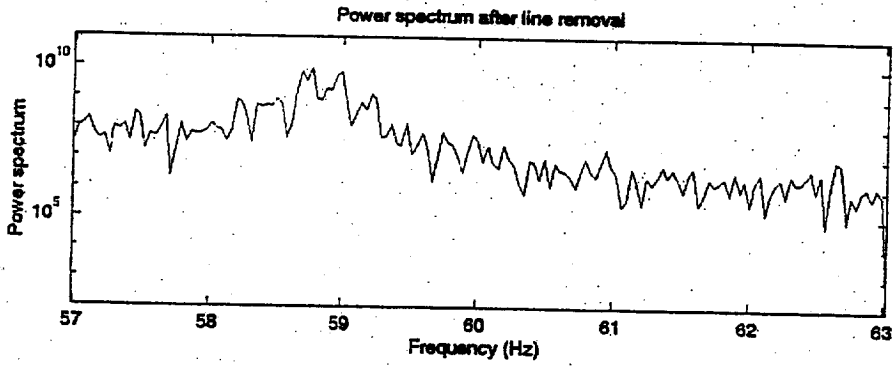
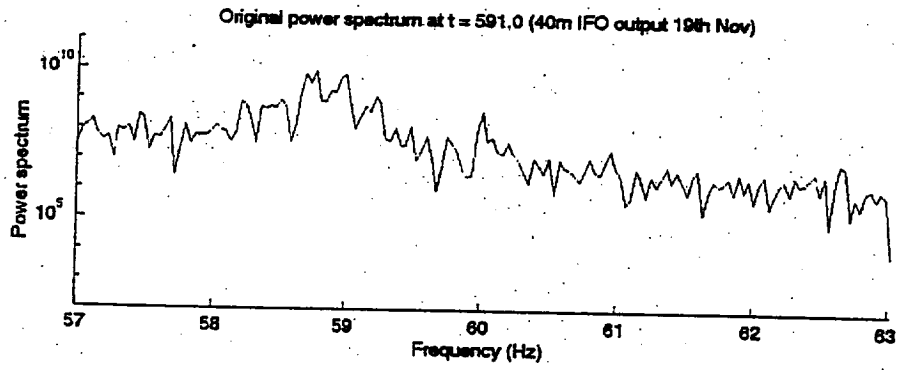


40m data

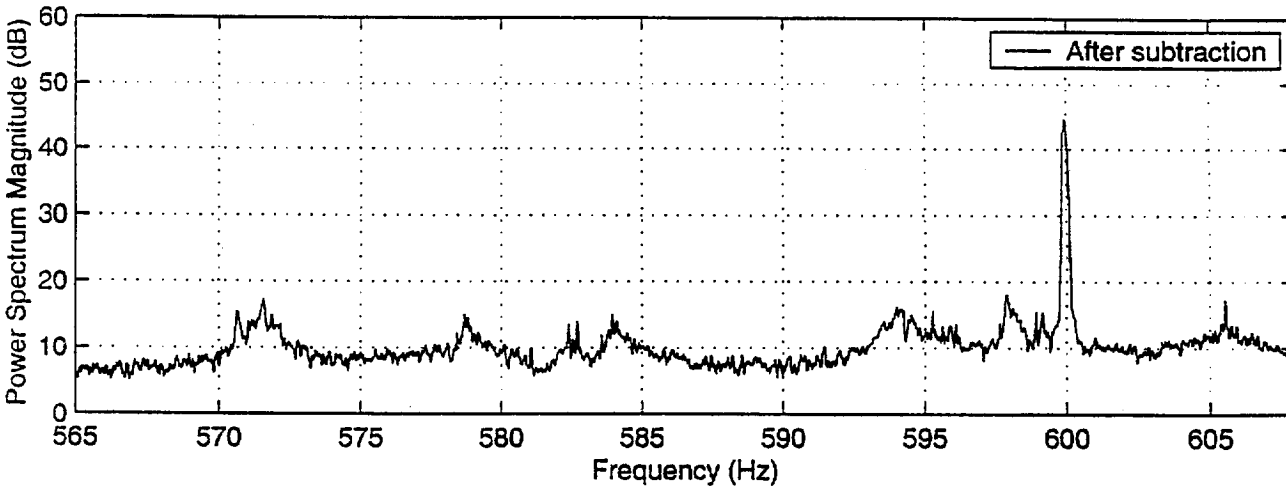
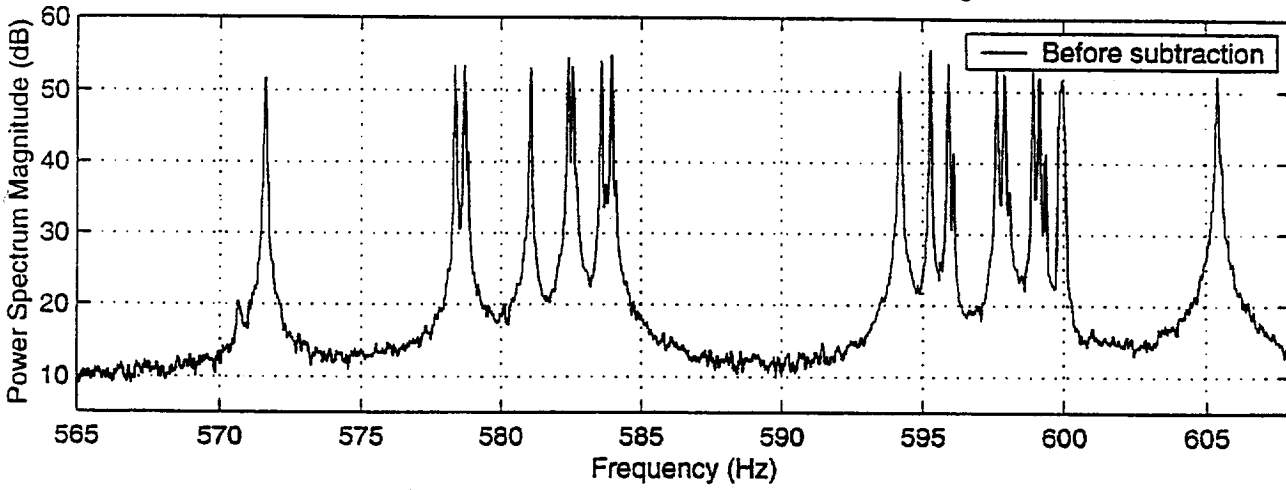


S.Klimenko

pic 5



Caltech 40m data, 19nov94.4/Locked004.nc, 20.43 minutes,  $f_s=9868.421$  Hz.



FILE 3.19.11.13.133

*Note 1, Linda Turner, 05/09/00 10:27:10 AM*  
LIGO-G000107-00-D