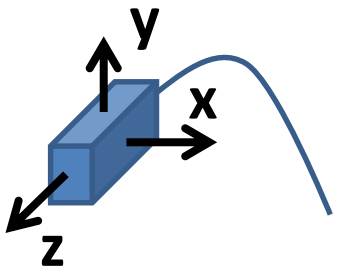
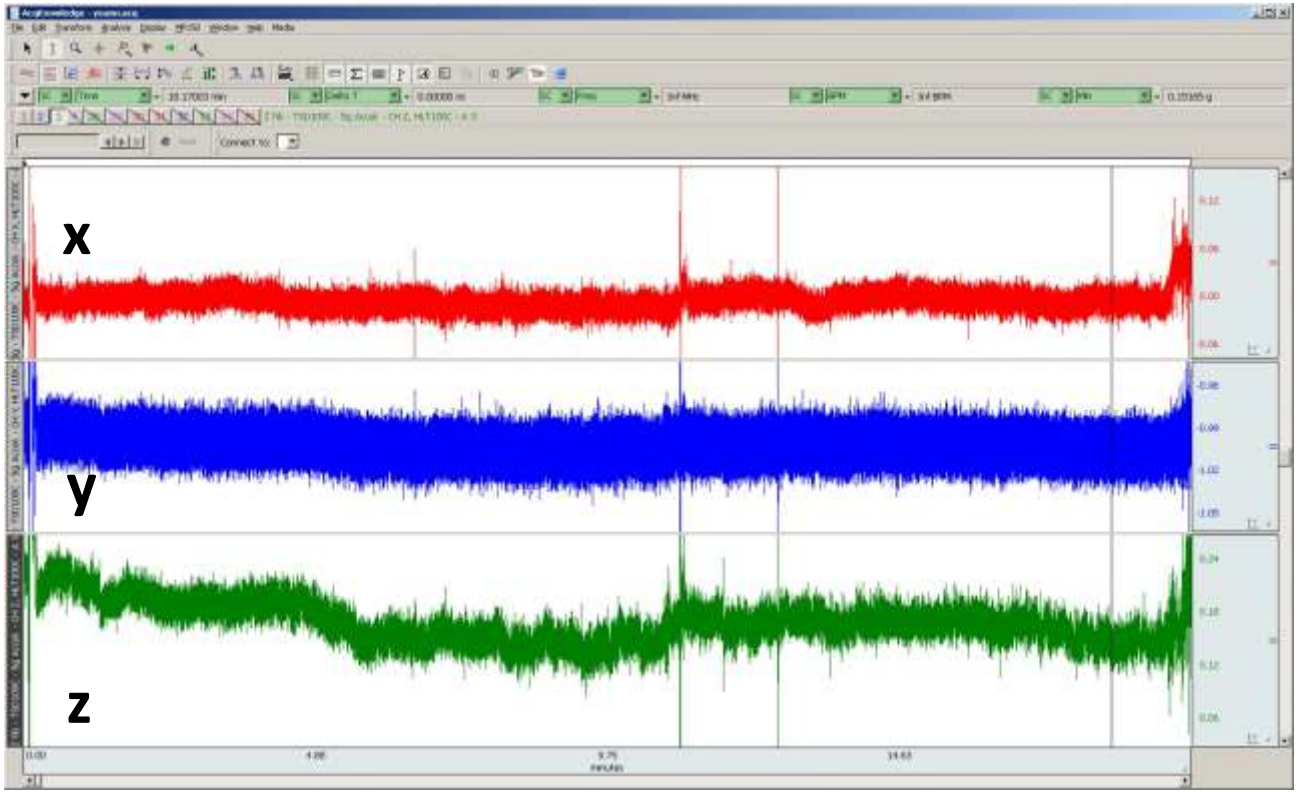
Accelerometer data filtering

TSD109C characteristics (BIOPAC)

- Channels: 3 – (X, Y, Z axis)
- Range (Output)
- TSD109C: ±5G (400 mV/G)
- TSD109F: ±50G (40 mV/G)
- Noise
- TSD109C: 325 µG/√Hz rms
- TSD109F: 2.5 mG/√Hz rms
- Bandwidth: DC – 500 Hz (-3dB)
- Nonlinearity: 0.2% of Full Scale
- Transverse Axis Sensitivity: ±2%
- Alignment Error: ±1°
- Package: Compliant silicone housing
- Power: +5V @ 9mA (via HLT100C)
- Sterilizable: Yes (contact BIOPAC for details)
- Cable Length: 3 meters
- Weight: 17 grams
- Dimensions: 33mm long, 28mm wide (at base), 19mm high
- Interface: HLT100C—see page 27
- TEL100C Compatibility: SS26 (5G) and SS27 (50G)—see page 236

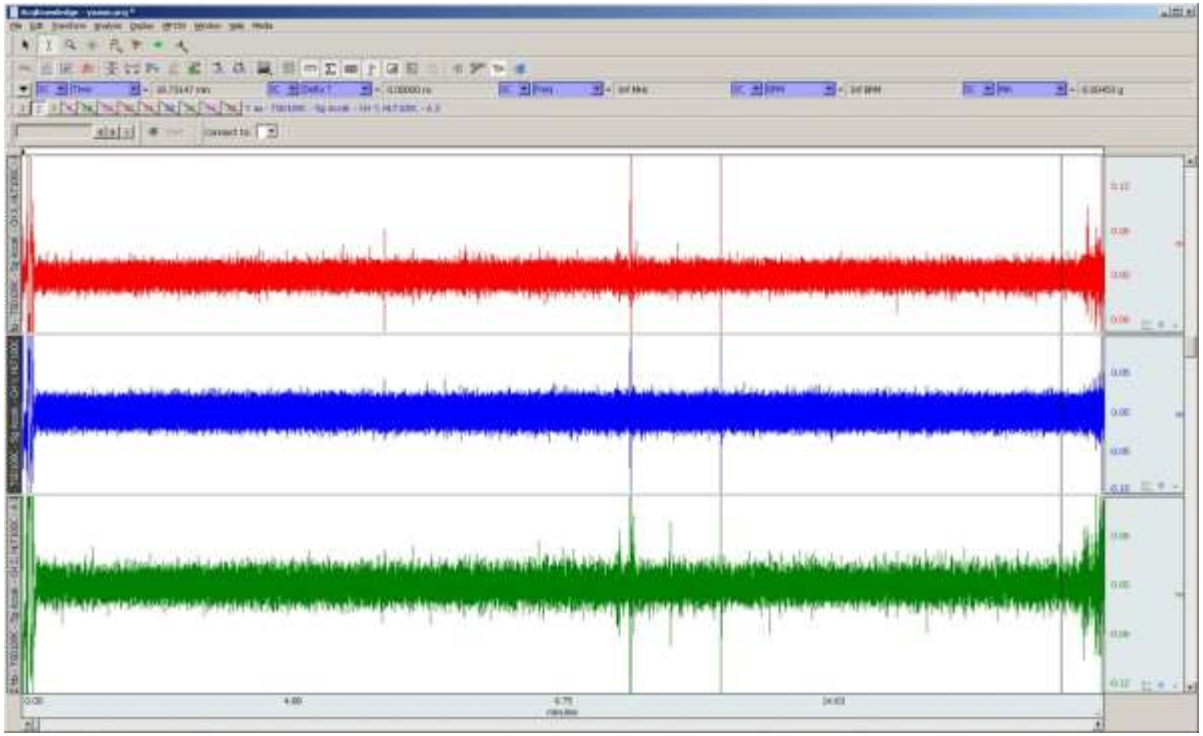
Raw signal



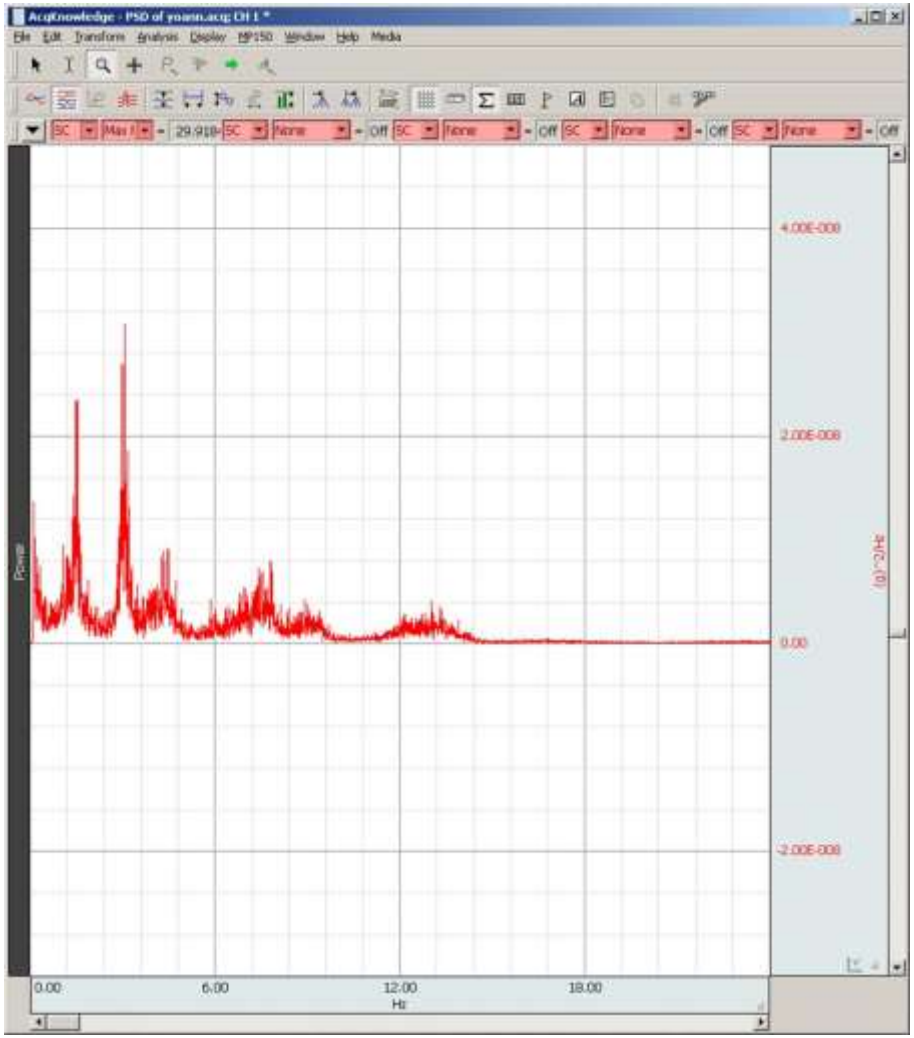


High pass filtering 0.1 Hz [FIR: Blackman -91 dB/slope]

- Will remove any slow movement > 10 seconds (ITI ~ 7 sec)



Low pass choice

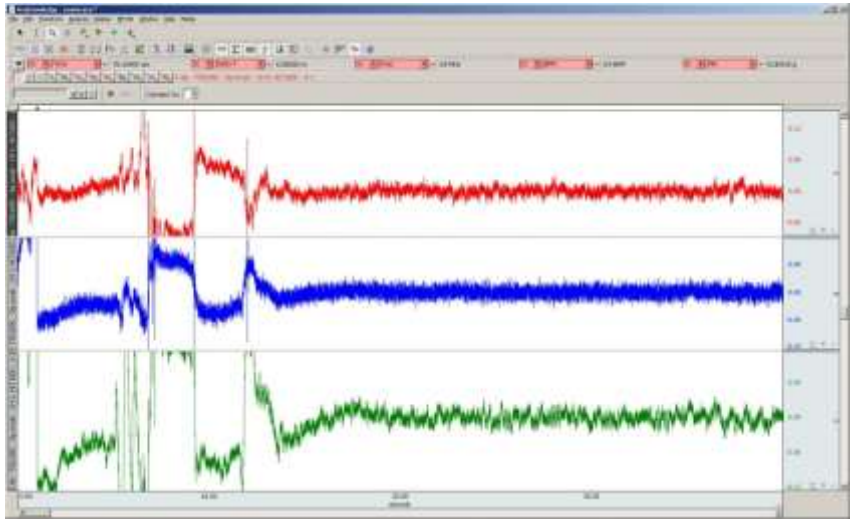


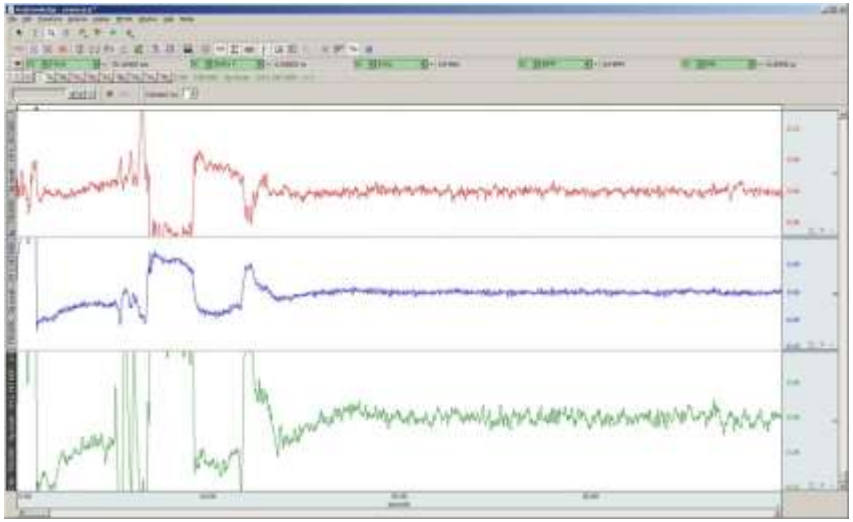
Most frequencies situated between 1 and 18 Hz
=> low pass 20 Hz [FIR: Blackman -91 dB/slope]

Low pass filtering efficiency

- Before

After





What is signal, what is noise?

- 1° What is noise?
  - Procedure: filtering XYZ signals 0.1 – 20 Hz when sensor not attached.
  - Root mean square calculation (0.03s windows, 20sec)
  - Results:
    - CHX: 88 $x10^{-6}$ G (±48 $x10^{-6}$) rms
    - CHY: 133 $x10^{-6}$ G (±72 $x10^{-6}$) rms
    - CHZ: 76 $x10^{-6}$ G (±44 $x10^{-6}$) rms

What is signal, what is noise?

- 2° What is signal?**(Specific for the current experimentation, cant be generalized)**
  - Root mean square calculation (0.03s windows) during experiment
  - Averaged rms on successive 20sec windows
  - Results:
    - CHX: 531 $x10^{-6}$ G (±398 $x10^{-6}$) rms
    - CHY: 344 $x10^{-6}$ G (±227 $x10^{-6}$) rms
    - CHZ: 851 $x10^{-6}$ G (±650 $x10^{-6}$) rms
- Conclusion signal to noise ration:
  - CHX snr = 531/81= 6.55
  - CHY snr = 344/133 = 2.58
  - CHZ snr = 851/76 = 11.19

From acceleration to velocity to distance

HP: 0.05Hz
LP: 20 Hz
Integral

HP: 0.05Hz
LP: 20 Hz
Integral

Acceleration (G) → Velocity (m/s) → Distance (m)