Digital Filters for Data Decimation

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Motivations

- Mobile (or at least OBS) data are usually only provided at one sampling rate, it would be useful to have a standard process to decimate them.
- OBS dataloggers may use commercial A/Ds that are not optimized for seismology data acquistion: does this have an effect on the recorded data?

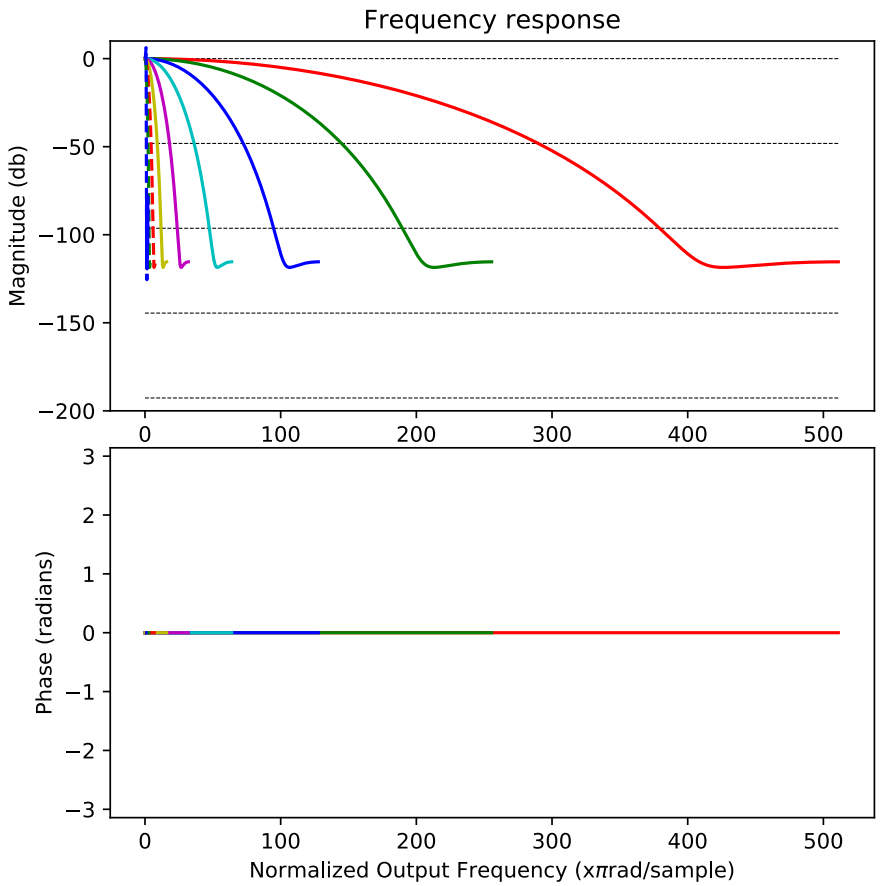
Goals

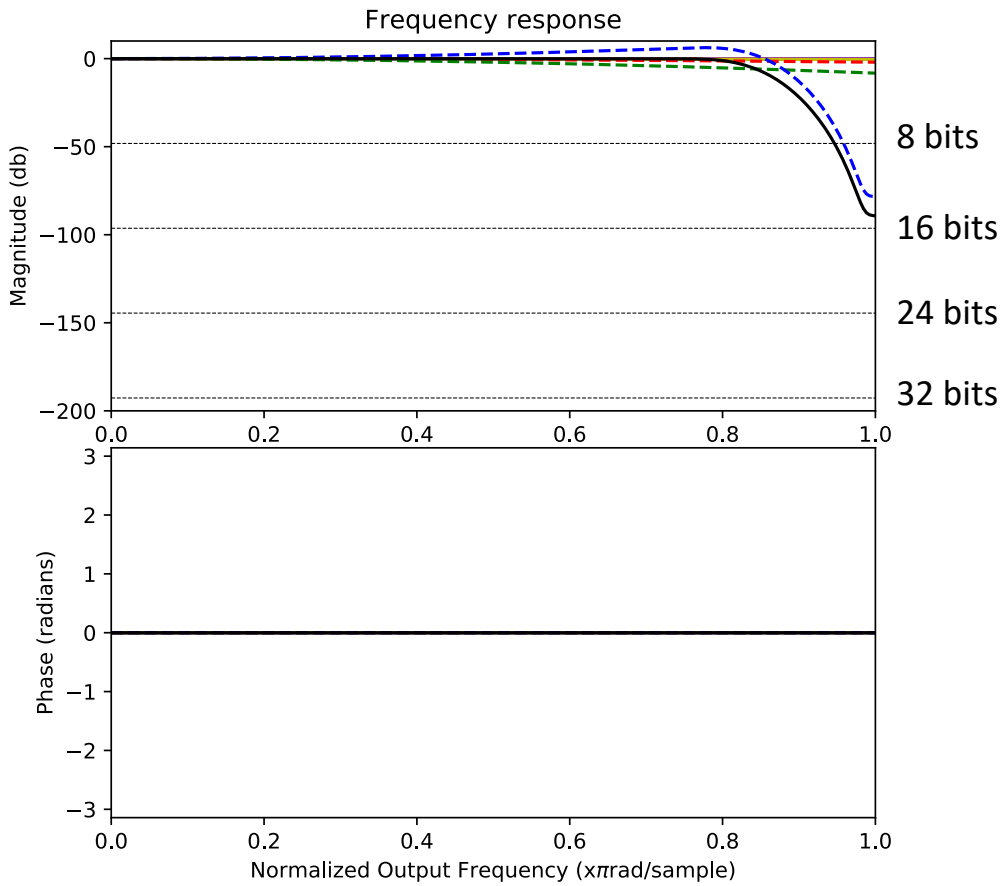
- Determine the effect of common decimation methods
  - Datalogger filters
  - SAC filters
  - Obspy
  - ???
- This effect may be more important when cutting off microseism energy, which may be as high as 130 dB (acceleration) or 60-70dB (velocity) above the low frequency noise floor

Tasks

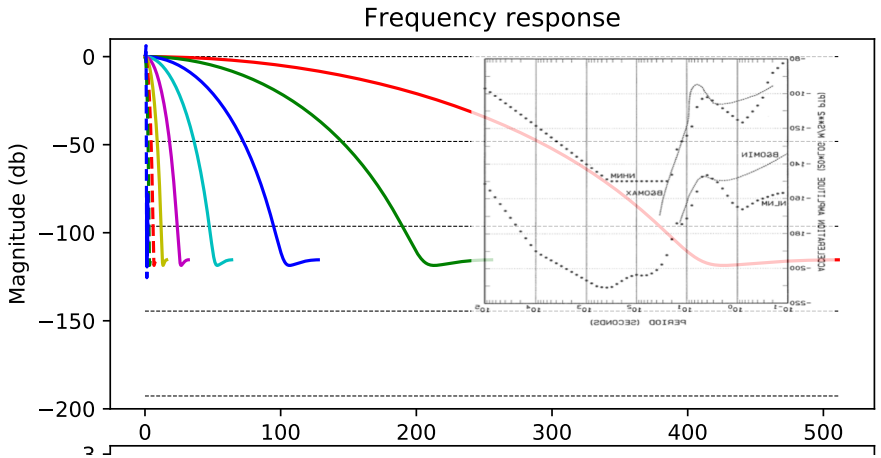
- Calculate the broadband noise floor of existing digital filters (Krishner and Crawford)
- Compare noise floor to expected signal dynamic range
- Compare spectra of decimated and original data

Frequency responses of each stage (CS5322)





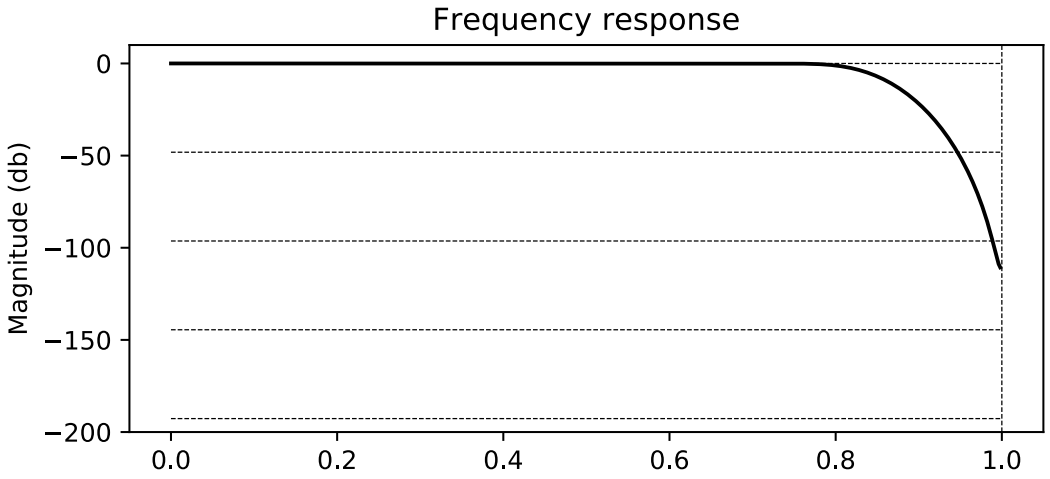
Frequency responses of each stage (CS5322)

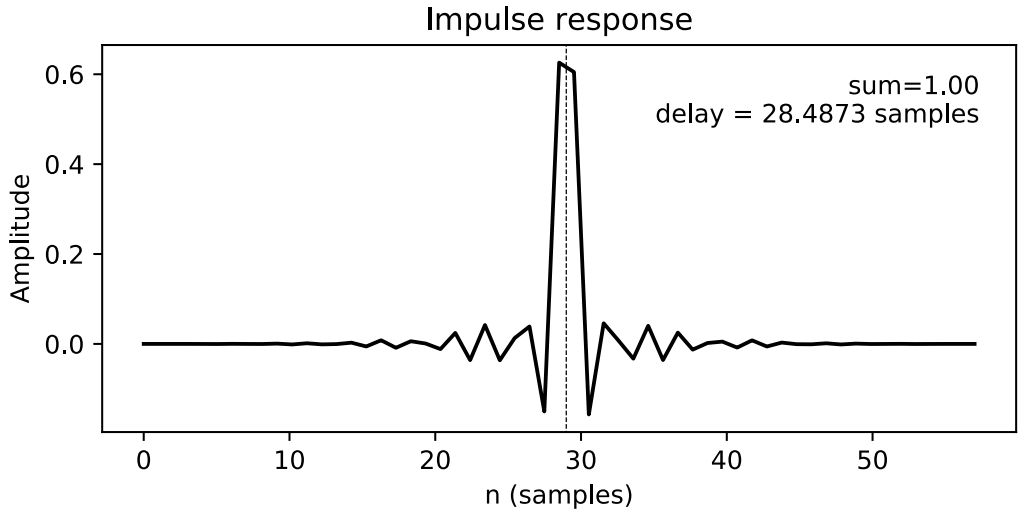


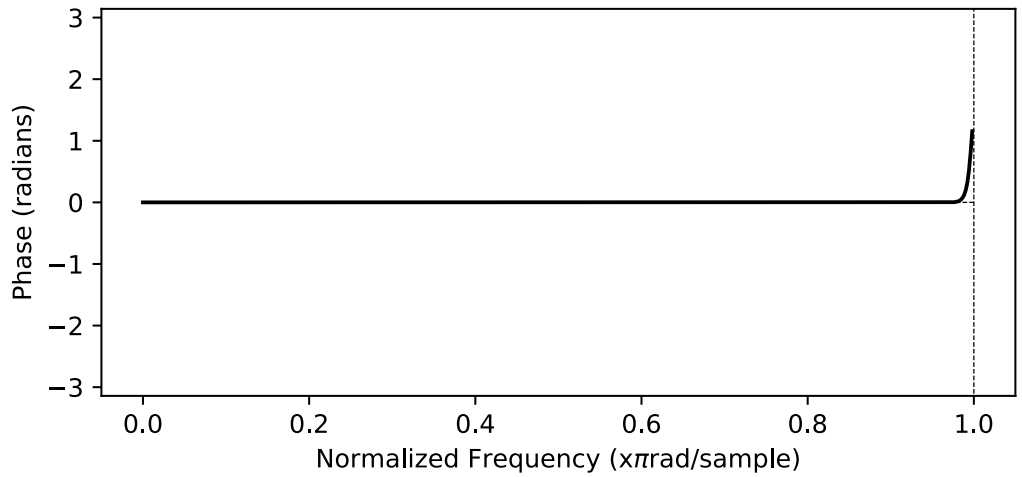
- If the broadband noise is higher than the difference between high and low noise levels, a high noise level at high frequencies could distort decimated data
- For an acceleration sensor (shown), the signal dynamic range is ~130dB. For a velocity sensor, it would be ~60-70 dB

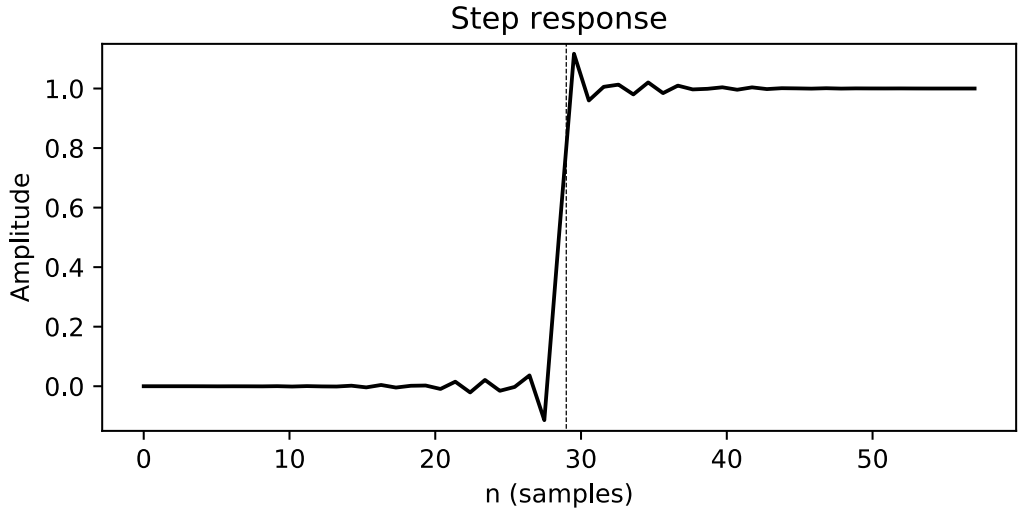
8 bits
16 bits
24 bits
32 bits

Frequency & impulse/step responses (CS5322)



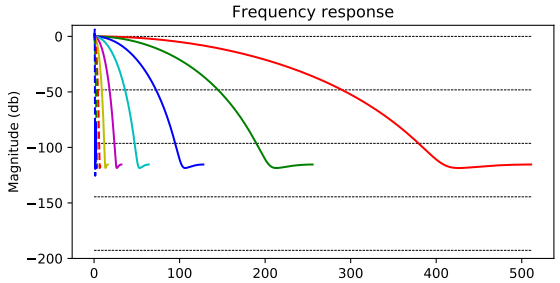


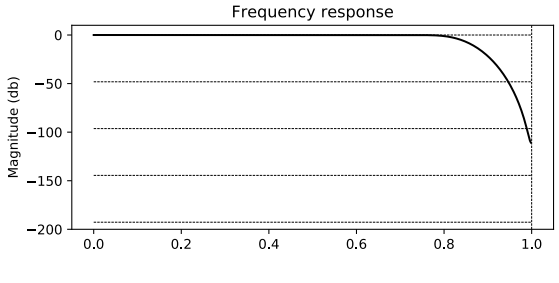


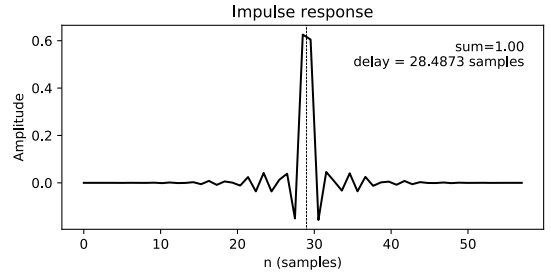


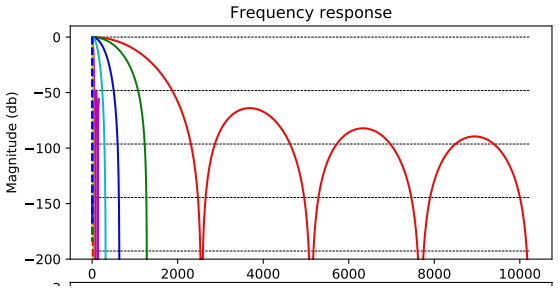
Digital filters

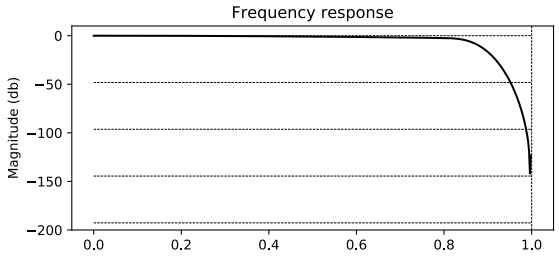
- Cirrus 5322
  (SIO LCHEAPO and INSU)
- SEND MCS (old German OBSs)
- TI ADS1281
  (new INSU)
- Guralp DM24

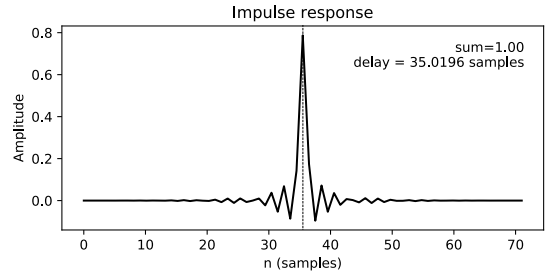


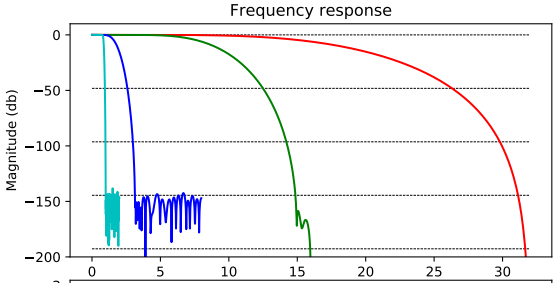


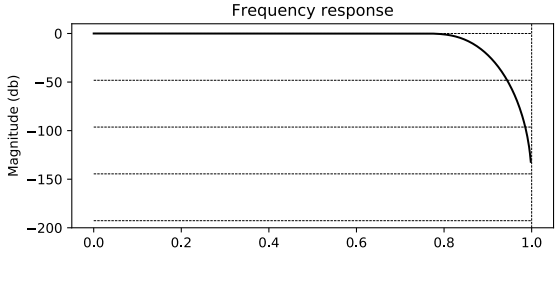


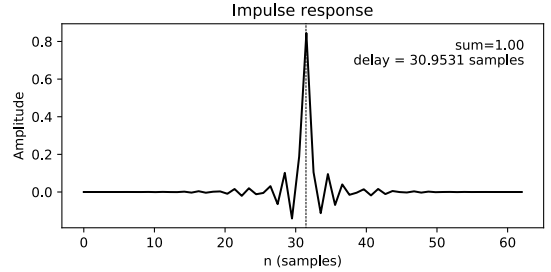


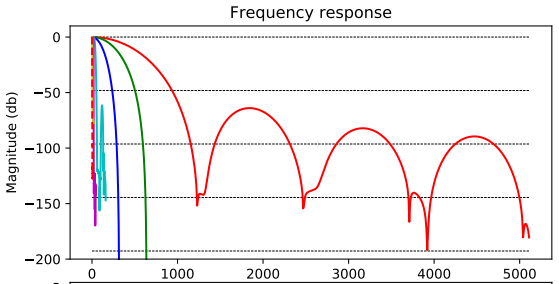


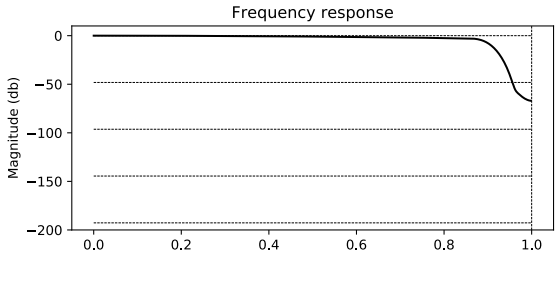


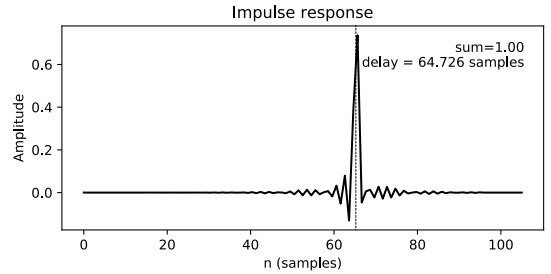






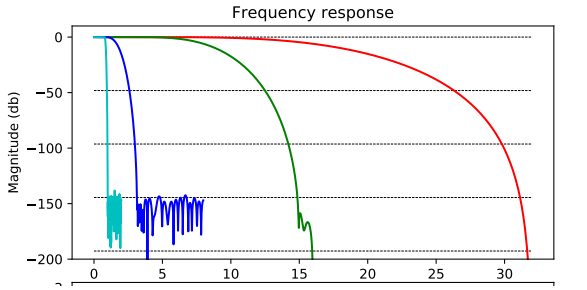


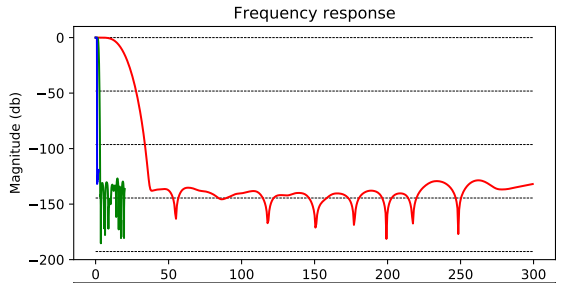


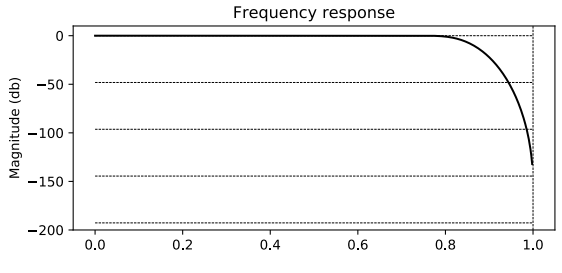


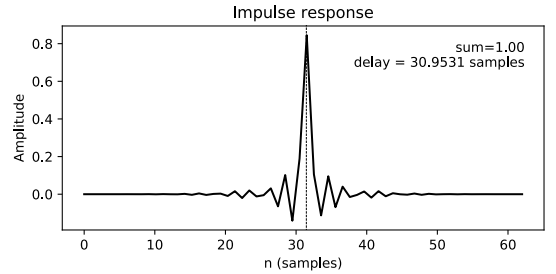
Digital filters

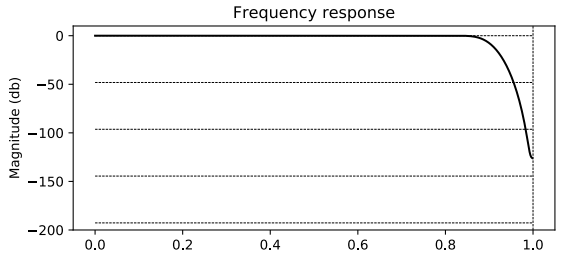
- TI ADS1281
- Taurus (100)
- Q330HR (100)
- SAC (dec4)

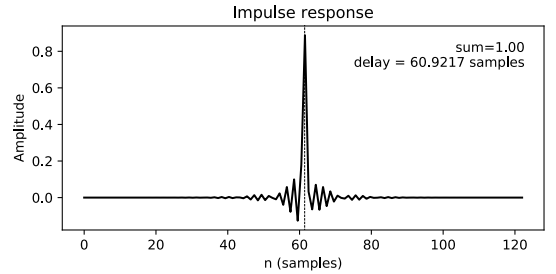


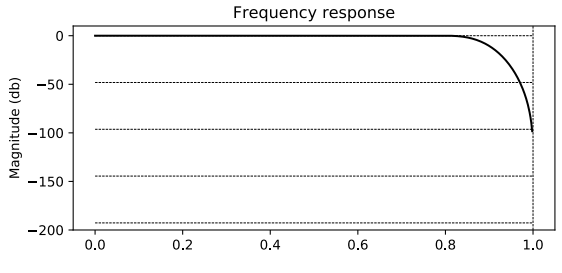


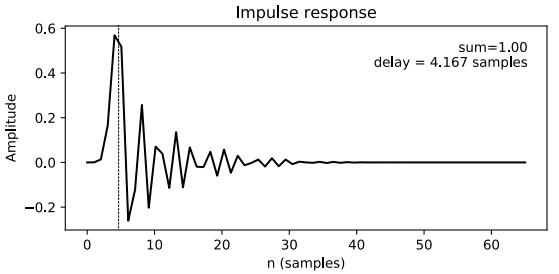


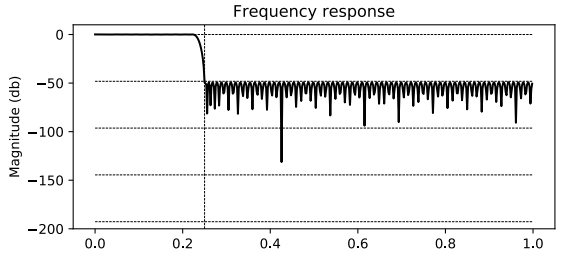


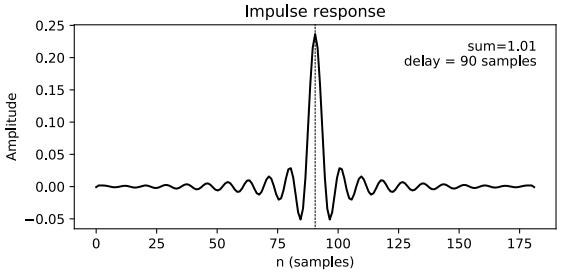












To Do

- Add collaborators?
- Determine acceptable limits
  - Using both theory and comparision of spectra
- Evaluate common decimation programs
  - Obspy, SAC, …?
- Make recommendations