Dynamic Range

How many decibels separate the largest and smallest numbers that can be represented with a given system. Things that have a dynamic range include

- computers
- seismic recording systems
- seismic processing systems
- plots

Dynamic Range

Definition of a decibel:

$$A_{db} = 20\log_{10}\frac{A}{A_{ref}}$$

$A =$ the amplitude under consideration (positive)

$A_{ref} =$ a reference amplitude

$A_{db} =$ The decibel representation of A

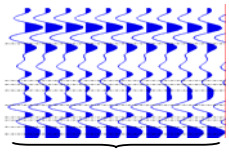
Dynamic Range

Decibel facts:

- An increase by a factor of 2 is +6db, a decrease is -6db
- 36db is 36/6=6 doublings
- All decibel measurements are relative to something
- Typical seismic processing systems have a dynamic range of 40-60db
- Seismic recording has a dynamic range of ~120db (e.g. 20 doublings separate the largest and smallest numbers that can be simultaneously recorded. 2^{20} ~ a million.
- Seismic plots have a dynamic range of ~12-24db. 2^4 ~ 16.

Dynamic Range

Example: Dynamic range of plotting:



10 traces/inch $\rightarrow$ 1 trace gets 1/10 inch

.01 inches is roughly the smallest discernable wiggle

plot dynamic range $\sim 20\log_{10}\frac{.01}{1/10} = 20\log_{10}(.1) = 20$

Dynamic Range

Example: 24 bit seismic system, assume 1 bit needed for sign and at least 2 bits of precision for the smallest number. If the largest number is 1, then the smallest number that can be represented is 2^{-22}

$$20\log_{10}\left(2^{-22}\right) = 20(-22)\log_{10}(2) \approx -440(.3) \approx 130db$$