Instrument Noise Testing

Albuquerque Seismological Laboratory
What we want to measure:

Instrument Noise + Site Noise + Instrument Sensitivity to installation + Seismic Noise = Noise

Really hard problem
Coherence Analysis

Install co-located sensors

Common signal

Incoherent noise
Different Methods

Three sensor (Sleeman)

Two sensor (Holcomb)

Raw Power
\[ y_i = h_i \cdot (x_i + n_i) \]

\[ y = \text{Seismometer Output} \]
\[ h = \text{Transfer Function} \]
\[ x = \text{Input to Seismometer} \]
\[ n = \text{Seismometer Noise} \]

\[ P_{ij} = H_i X_i \overline{H_j X_j} \]

Cross-Power

\[ N_{ii} = \left( P_{ii} - P_{ij} \frac{p_{ik}}{p_{jk}} \right) / (H_i \overline{H_j}) \]

Sleeman Noise

A little bit of math and you can solve for the noise
Velocity Sensors

Using multiple sensors over multiple tests we can make a point-wise low-noise model for a sensor.
Accelerometers (New)

Noise models for accelerometers

Not using coherence since site noise is below sensor noise
Atmospherically induced tilt makes it difficult to estimate horizontal self-noise.

Tilt across ASL vault

Pressure

Estimated using 9 STS-2s across the vault
Given tilt and instrument sensitivity to non-seismic noise sources what is “Instrument self-noise”?

Is an instrument that pulses, but is quiet between pulses a quiet instrument?

Is an instrument that is noisy in field conditions, but quiet when tested a noisy instrument?

How long should be allowed for an instrument to settle before we call it the instrument’s self-noise?
Co-locate sensors and remove common signal to get *incoherent* noise

In ideal situation this is the “self-noise”

By doing multiple tests you can approx. the self-noise of a model of sensor

Horizontal noise is difficult to characterize because of tilt

No consistent definition of *INSTRUMENT* self-noise
silly earth
you shouldn't be crossing
the street you are earth
you didn't even look
both ways


