Sensor Suite: The Albuquerque Seismological Laboratory Instrumentation Testing Suite

D. C. Wilson[1], A. Kearns[2], A. T. Ringler[1], J. Holland[1], T. Storm[1], and R. E. Anthony[1]

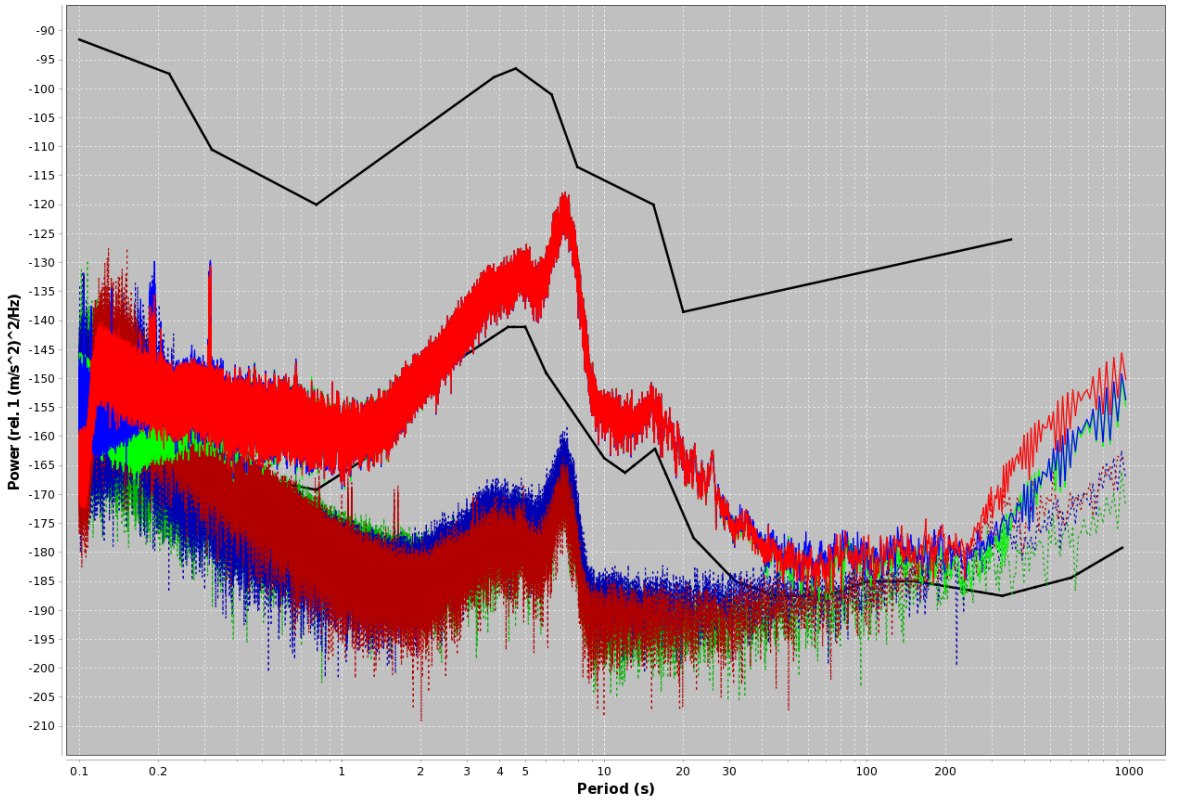
[1]U. S. Geological Survey, Albuquerque Seismological Laboratory

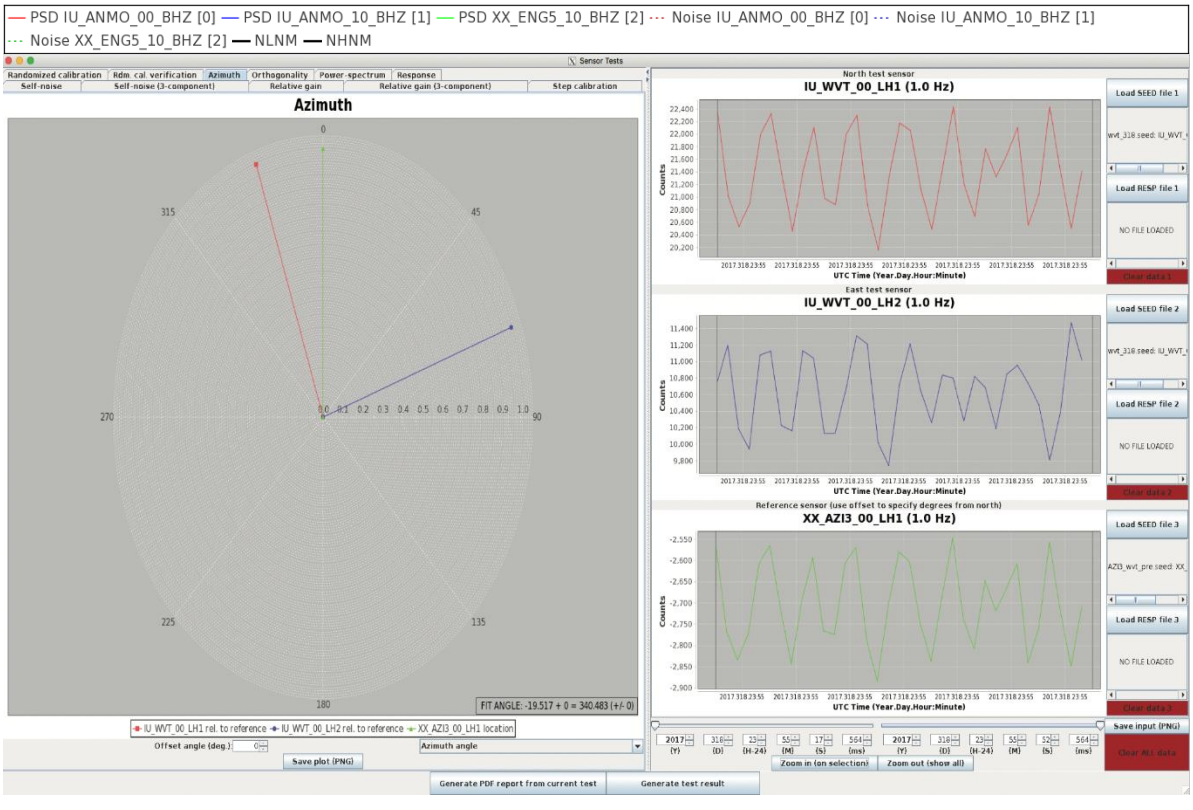
[2]KBRwyle Technology Solutions Incorporated, Albuquerque Seismological Laboratory

Abstract

In order to allow the casual user (geophysicists without expertise in instrumentation) to quickly and consistently determine several parameters critical to determining seismometer health, we have developed a new seismometer testing software package called: Albuquerque Seismological Laboratory (ASL) Sensor Test Suite. The package is written in Java and makes use of Seismological Exchange for Earthquake Data (SEED) format. The sensor tests, which include computing sensor self-noise, relative gain, azimuth, and processing calibrations to determine poles and zeros, can be calculated in a standardized way so that results can be directly compared between tests and between different groups. For the self-noise and the relative azimuth, we also include three component versions of these tests to allow for the case of sensors with potentially different orientations (e.g. boreholes). Our goal is to focus on a few of the instrumentation tests we view as critical when verifying a sensor's performance. The package is extremely flexible so that it can be used to troubleshoot issues with a single sensor or to compute multi-component self-noise of several sensors in a laboratory setting. The software has been made available on GitHub (https://github.com/usgs/asl-sensor-suite) with the hope that it will be useful for other seismologists who need to quickly verify various sensor parameters without having to write their own versions of the algorithms. Furthermore, by using a common platform and processing algorithms it becomes possible to compare results between different tests and between different groups with similar processing methods being used for both.

Self-noise


Power (rel. 1 (m/s^2)^2/Hz)
-90
-95
-100
-105
-110
-115
-120
-125
-130
-135
-140
-145
-150
-155
-160
-165
-170
-175
-180
-185
-190
-195
-200
-205
-210
0.1
0.2
1
2
3
4
5
10
20
30
100
200
1000
Period (s)


PSD IU_ANMO_00_BHZ [0]
PSD IU_ANMO_10_BHZ [1]
PSD XX_ENG5_10_BHZ [2]
Noise IU_ANMO_00_BHZ [0]
Noise IU_ANMO_10_BHZ [1]
Noise XX_ENG5_10_BHZ [2]
NLNM
NHNM
Sensor Tests
Randomized calibration
Rdm. cal. verification
Azimuth
Orthogonality
Power-spectrum
Response
Self-noise
Self-noise (3-component)
Relative gain
Relative gain (3-component)
Step calibration
Azimuth
FIT ANGLE: -19.517 + 0 = 340.483 (+/-0)
IU_WVT_00_LH1 rel. to reference
IU_WVT_00_LH2 rel. to reference
XX_AZI3_00_LH1 location
Offset angle (deg.):
Azimuth angle
Save plot (PNG)
North test sensor
IU_WVT_00_LH1 (1.0 Hz)
Counts
UTC Time (Year.Day.Hour:Minute)
Load SEED file 1
Load RESP file 1
NO FILE LOADED
East test sensor
IU_WVT_00_LH2 (1.0 Hz)
Load SEED file 2
Load RESP file 2
Reference sensor (use offset to specify degrees from north)
XX_AZI3_00_LH1 (1.0 Hz)
Load SEED file 3
Load RESP file 3
Save input (PNG)
Clear ALL data
Zoom in (on selection)
Zoom out (show all)
Generate PDF report from current test
Generate test result

CAPTION:

Upper Panel - Power Spectral Density (PSD) estimates (solid lines) for the vertical components of a Nanometrics Trillium 360 sensor (green), as well as the primary KS-54000 (red, location code 00) at IRIS/USGS network (network code IU) station ANMO (Albuquerque, New Mexico), and the secondary sensor at ANMO (location code 10) a Nanometrics Trillium 120. The self-noise estimates are shown as dashed spectra of slightly darker color. We have included the Peterson (1993) New Low/High-Noise Model (NLNM/NHNM) in black for reference.

Lower Panel - Azimuth estimate of the IRIS/USGS (network code IU) station WVT (Waverly, Tennessee). The azimuth of the primary Streckeisen STS-6 sensor (location code 00) horizontal components (LH1, red; LH2, blue) were estimated using a co-located Trillium compact (green) where the sensor was oriented to North using a gyroscopic compass. The azimuth of the STS-6 was found to be 340 degrees (left). The time windows used for this estimate are shown on the right.