SeismiX™ Tri-Axial Accelerograph with Dynamic Motion Logger

SeismiX™ TRI-AXIAL ACCELEROGRAPH SPECIFICATIONS

SeismiX™ TRI-AXIAL ACCELEROGRAPH v1.2

Model: EEWS Series

SeismiX™ Tri-Axial Accelerograph is an innovative early warning system designed to provide rapid alerts for earthquakes and other seismic events by measuring ground acceleration with high precision. The "**SeismiX™ Tri-Axial Accelerograph"** is used for Rapid Acceleration Monitor having dynamic motion logger. It has capability to measure ground acceleration up to four times the acceleration of "g," where "g" represents the standard acceleration due to gravity. **SeismiX™** Accelerograph is distinguished by its ability to measure the acceleration of seismic pulses at high speed and accuracy, enabling early detection and timely warnings to mitigate the impact of seismic hazards.

It is developed as a part of the ongoing evolution of seismic monitoring and alert systems, **SeismiX™** Accelerograph represents a significant advancement in the field of earthquake early warning (EEW) systems.

SeismiX™ integrates advanced technology and real-time data analysis capabilities to deliver actionable alerts to individuals, organizations, and communities in order to get timely warnings and mitigate the impact of seismic hazards.

Key Features and Components:

1. **High-Sensitivity Accelerometers**: **SeismiX™** Accelerograph is equipped with high-sensitivity accelerometers capable of detecting even minor ground accelerations with exceptional accuracy. These accelerometers are strategically deployed in seismically active regions to monitor ground motion continuously.

2. **Tri-axial Accelerograph: SeismiX™** is equipped with tri-axial MEMS. This Accelerograph is capable of measuring ground acceleration along three orthogonal axes (X, Y, and Z), providing comprehensive data on seismic motion in three dimensions.

3. **Real-Time Data Analysis**: The system utilizes advanced algorithms and real-time data processing techniques to analyse ground acceleration data and identify seismic pulses associated with earthquakes and other seismic events. By focusing on the acceleration of seismic waves, **SeismiX™** Accelerograph can rapidly detect the onset of seismic activity and assess its magnitude and intensity. The Accelerograph detects the P wave and estimate s whether the following shockwave is potentially devastating or not, all within 3 seconds. As the P wave travels twice as fast as the main seismic activity (S -Wave) and surface waves, it can estimate the shock wave arrival time. This depends on the epicentre and **SeismiX™** distance.

4. **4G Threshold Alerting: SeismiX™** Accelerograph employs a threshold alerting mechanism based on the measurement of ground acceleration relative to four times the acceleration of "g." When seismic activity exceeds the predetermined threshold, indicating significant ground acceleration, the system triggers an alert to notify users of the impending seismic event.

5. **Immediate Alerting:** Upon detecting seismic activity surpassing the 4G threshold, **SeismiX™** Accelerograph issues immediate alerts to designated recipients via various communication channels, including mobile devices, sirens, and integrated alerting platforms. These alerts provide valuable seconds to minutes of advance warning, enabling individuals and organizations to take proactive measures to protect themselves and mitigate risks.

6. **Customizable Alert Settings**: Users have the flexibility to customize alert settings and response protocols based on their specific requirements and risk tolerance levels. **SeismiX™** Accelerograph allows users to define alert thresholds, notification preferences, and response actions, ensuring that alerts are tailored to the unique needs of each user or organization. Earthquake data is also recordable when connected to PC using software provided enabling monitoring of quakes and effect on infrastructure.

7. **Integration with Emergency Response Systems**: **SeismiX™** Accelerograph seamlessly integrates with existing emergency response systems, public safety infrastructure, and disaster management agencies to facilitate coordinated response efforts. By providing timely and accurate information to emergency responders and authorities, the system enhances preparedness, coordination, and resilience in the event of seismic hazards.
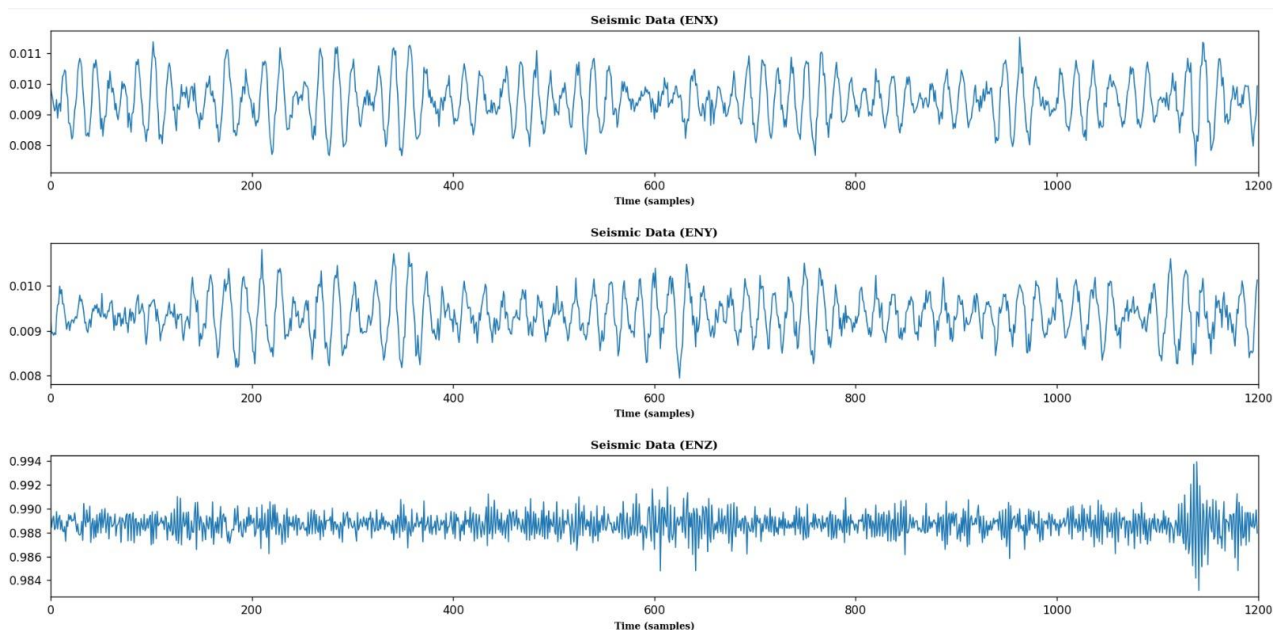
Tri-axial data received from **SeismiX™** Accelerograph

Technical Features

- Range ±4g
- Self-testing and calibration.
- User-selectable communication methods and data packaging. *(Currently configured for mSEED)*
- Accurate RTC clock with Network support.
- 1000 Mbps Ethernet link.

- USB 3.2 datalink support
- Electronics and power supply failure detection and relaying.
- Integrated digital system for environmental parameters compensation (like temperature and altitude) for better noise floor and dynamic range.
- MIL-STD for hardware for robustness.
- Integrated digital engine for implementing Probabilistic early warning algorithms for ground motion detection.
- AI-based models for self and supervisor learning can be embedded onboard.

SPECIFICATIONS

Parameters	Specifications
Accelerometer	
Accelerometer	Tri-Axial MEMS
Type	Digital
Full-Scale acceleration	+2g to -2g
Frequency Response	DC to 250Hz
Accuracy/Dynamic range	97db at Hz
Noise Density/White Noise	16.5 µg/√Hz
Bandwidth (±3dB)	550 Hz
Scale Factor Sensitivity	900 mV/g
Non-Linearity	1 % , IEEE Norm , % of full scale
Quality factor	10 a.u
Start-up time	20 µs
Displacement Frequency	
Response	0.075 HPF
Shock	1500 g 0.15ms 10000 g 0.1ms, Single Shock
Vibration	20 g, Random/20-2000 Hz
ESD stress	HBM Model
Resolution	
Output Resolution:	16 Bit
Earthquake Gauge	
Algorithm	
STA Setting Range	0.1 ~100 seconds
LTA Setting Range:	0.1 ~200 seconds
Event Duration Time	1-200 Seconds
Switch Set-points	
Digital Output Numbers	
Set -point Range	
Contact Type	Normal Open
Contact Capacity	60V / 0.6 ADC
Hold-On time	User Defined
Power	
Supply Voltage(V_{DD})	10~30 VDC
Supply current (I_{DD})	22-32 mA

Power (12V):	3.5 W
Operating power consumption	90 mW
Input / Output	
Modbus RTU:	RS -232 or RS -485 format 19200, N, 8, 1
Modbus TCP	3 Hosts Simultaneously
Modbus ID	Default 101, settable
Modbus function:	Function 3 and 16
Active Connect to TCP Server	Support 2 TCP Servers
Time Calibration	PC utility
Data Recording	Via Network by PC Utility
Size	
Dimension	200 * 200 * 70 mm
Weight	3.5 kg
Environment	
Operation Temp.	-40 to +85 °C
Storage Temp.	-20~70 °C

Different Sensor capacity Comparison

Application	Piezoelectric	Capacitive MEMS	Piezoresistive
Static Acceleration (0 Hz, 1g) Gravity, Sensor Orientation		✓	✓
G Force (0 Hz, <25 g) Rocket, Centrifugal, Aircraft		✓	✓
Seismic (<1g) Earthquake, Waves, Bridges	✓		
Low-Frequency Vibration (<5 Hz, <25g) Human Motion, Robotics	✓	✓	✓
General Vibration (5Hz to 500 Hz, <25g) Electric Motor, Car Suspension	✓	✓	
High Frequency Vibration (>500 Hz, <25g) Gear Noise Analysis, Turbine Monitoring	✓		
General Shock (<100 Hz, <200g) General Testing, Shock Absorber Testing	✓	✓	✓
High Impact Shock (<250 Hz, >200g) Drop Testing	✓		✓
Extreme Shock (>1000 Hz, >2000g) Vehicle Crash Testing, Metal on Metal	✓		✓

Sample Recorded Data:

X-axis Baseline Correction Frequency Range 0.075 Hz to 35 Hz

Y-axis Baseline Correction Frequency Range 0.075 Hz to 35 Hz

Z-axis Baseline Correction Frequency Range 0.075 Hz to 35 Hz

X-axis Baseline Correction Frequency Range 0.075 Hz to 2 Hz

Y-axis Baseline Correction Frequency Range 0.075 Hz to 2 Hz

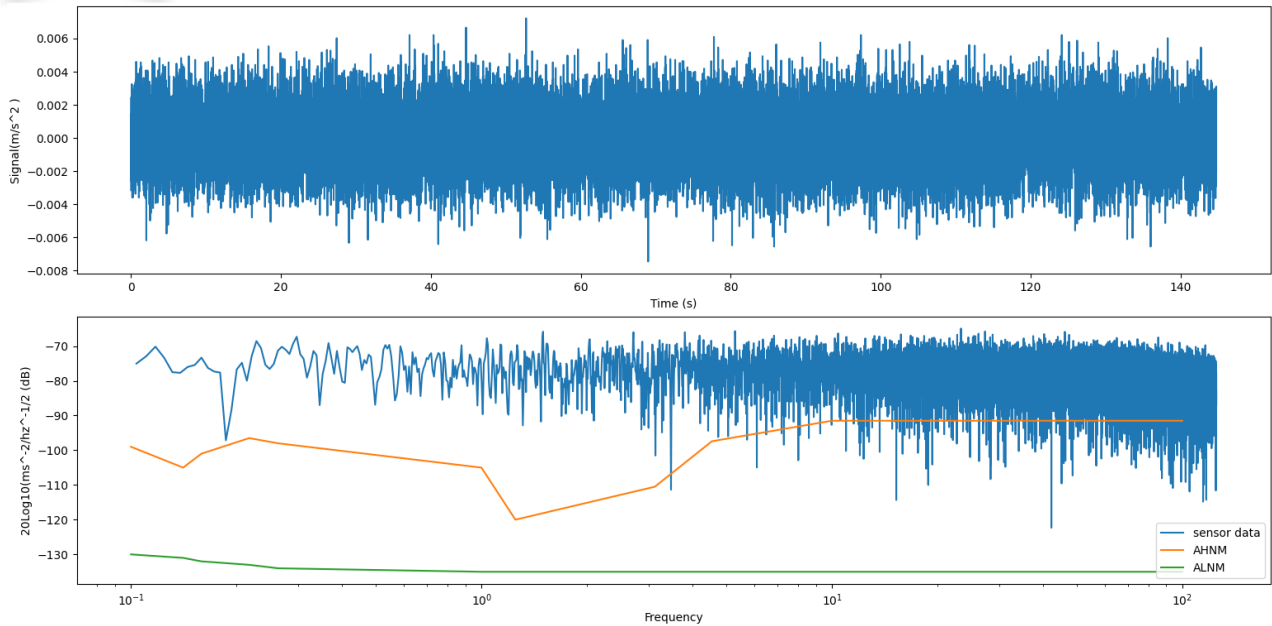Z-axis Baseline Correction Frequency Range 0.075 Hz to 2 Hz
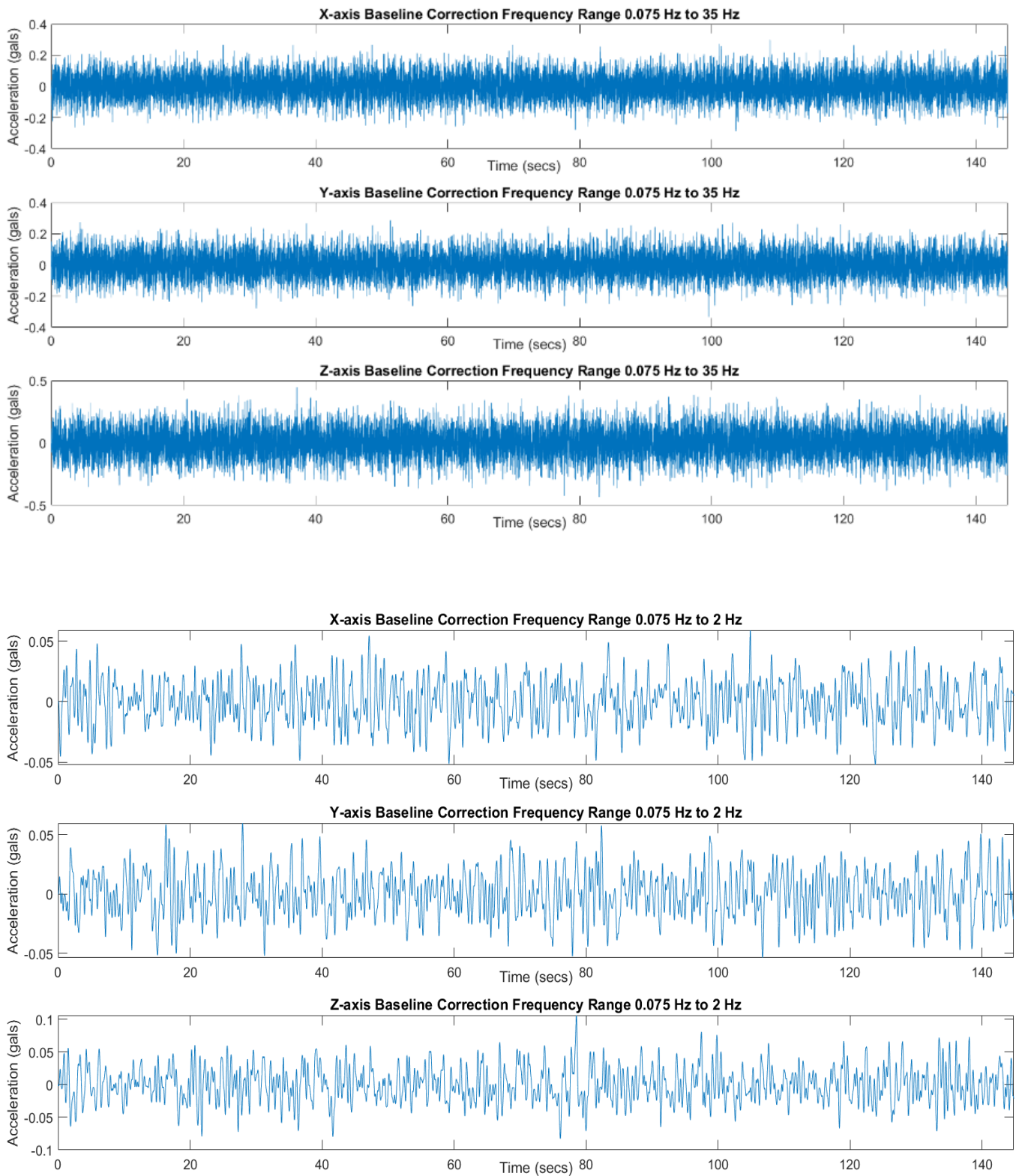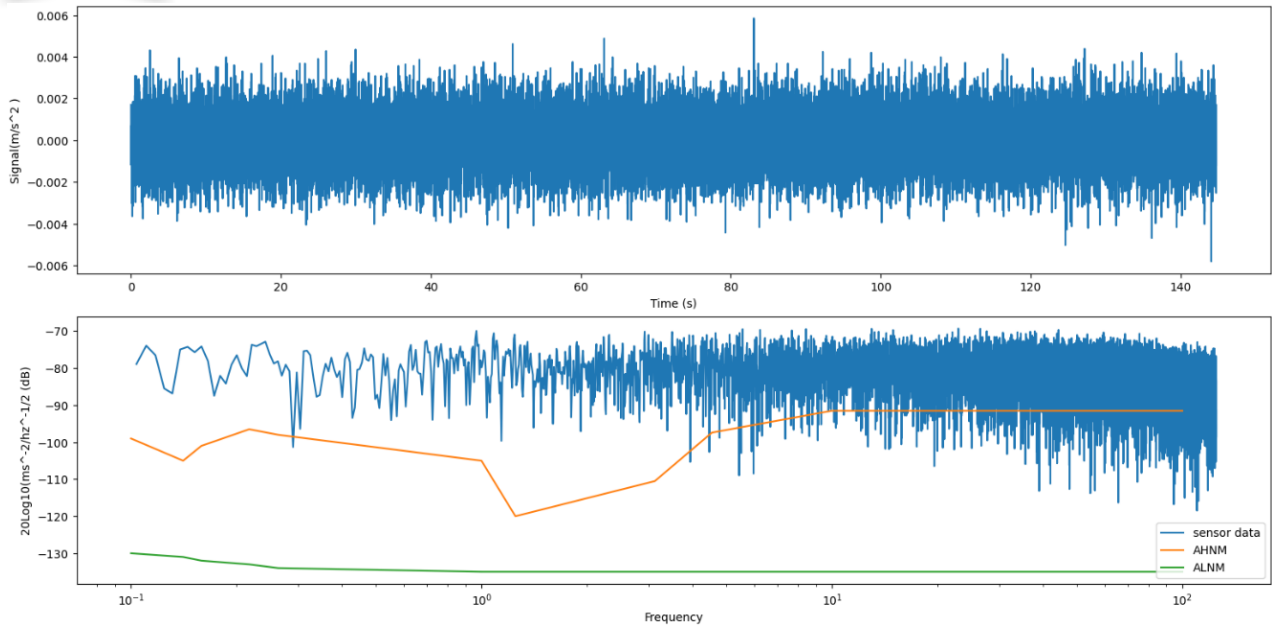
Ground motion (X-axis) as recorded at the site (top) and its PSD calculated as per Welch's method (Cauzzi and Clinton, 2013; Welch, 1967) plotted along with AHNM and ALNM.
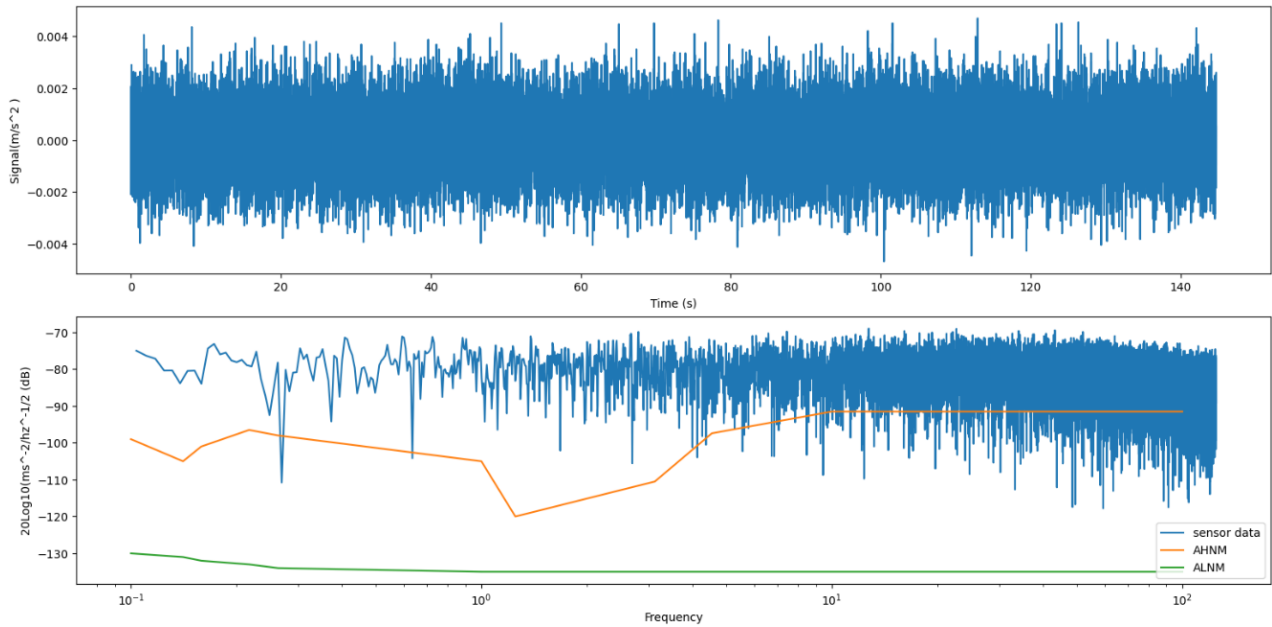
Ground motion (Y-axis) as recorded at the site (top) and its PSD calculated as per Welch's method (Cauzzi and Clinton, 2013; Welch, 1967) plotted along with AHNM and ALNM.

Ground motion (Z-axis) as recorded at the site (top) and its PSD calculated as per Welch's method (Cauzzi and Clinton, 2013; Welch, 1967) plotted along with AHNM and ALNM.

Benefits:

- **Enhanced Early Warning Capability**: **SeismiX™** Accelerograph enhances early warning capability by detecting significant ground acceleration indicative of seismic events, providing advanced notice of impending earthquakes or other seismic hazards.

- **Rapid Response and Mitigation**: Immediate alerts issued by **SeismiX™** Accelerograph enable rapid response and mitigation measures, helping individuals and organizations minimize the impact of seismic events on lives, property, and infrastructure.

- **Improved Safety and Preparedness**: By delivering actionable alerts and enabling timely response actions, **SeismiX™** Accelerograph contributes to improved safety, resilience, and preparedness in earthquake-prone regions, ultimately saving lives and reducing the risk of injuries and damages.

Applications:

For structural health monitoring of
- Major bridges
- Dams
- High-rise buildings
- Structures of importance
- upcoming expected high-speed trains,

All these factors make the Earthquake Early Warning (EEW) system need of the hour.

EoD.