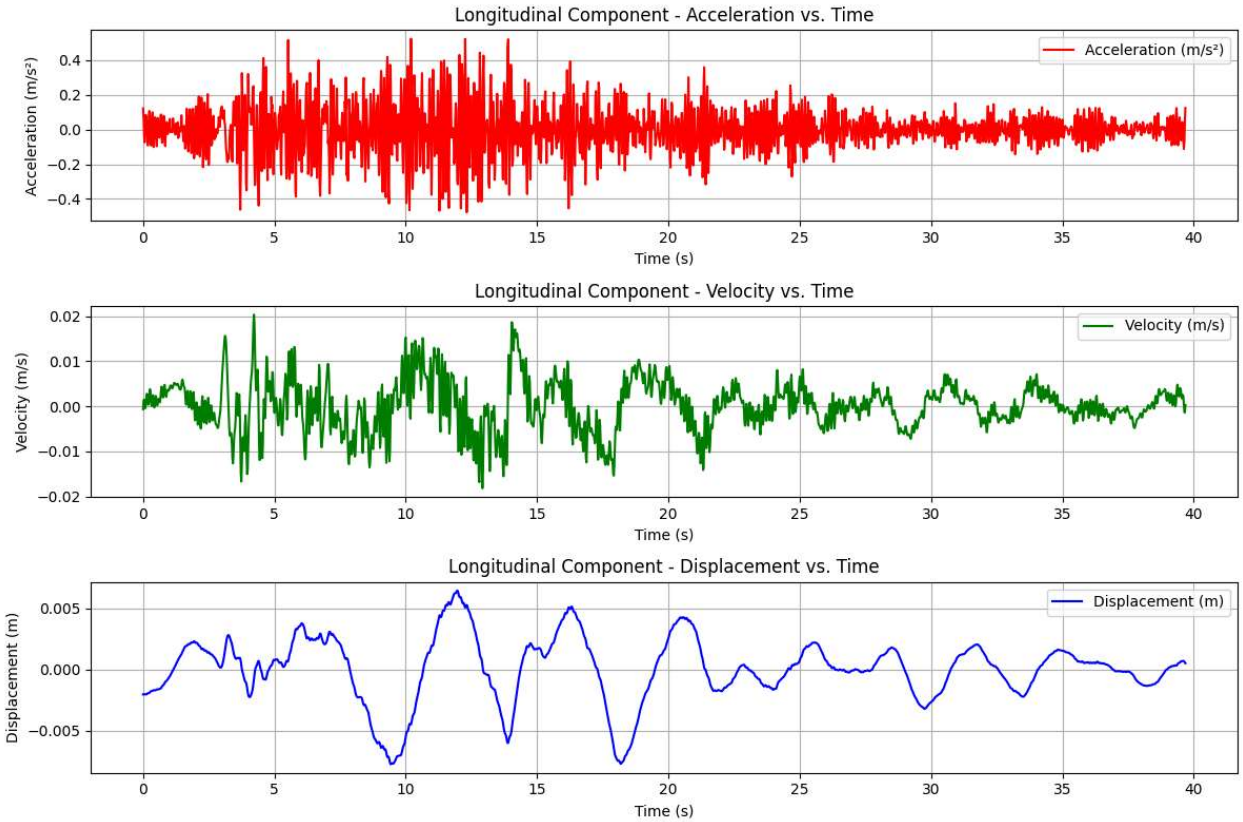
Introduction

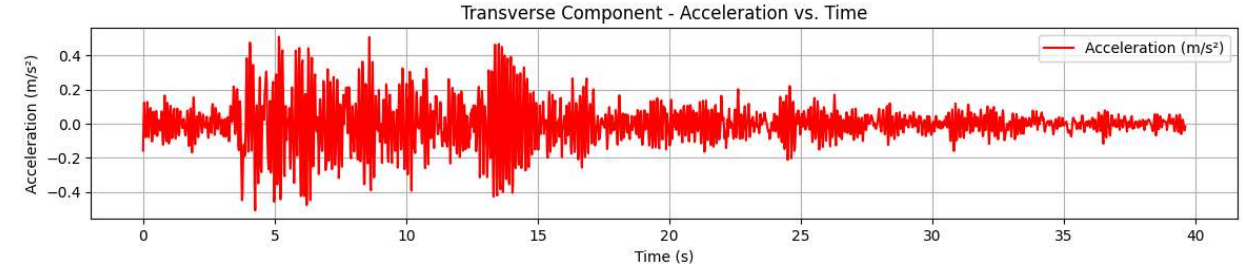
This report presents an analysis of seismic data recorded in the AUTTA and ATEHR regions. The study focuses on evaluating ground motion characteristics through acceleration, velocity, and displacement time series, as well as spectral analysis techniques like the Evolutionary Power Spectral Density (EPSD) and Fourier Response Spectrum.

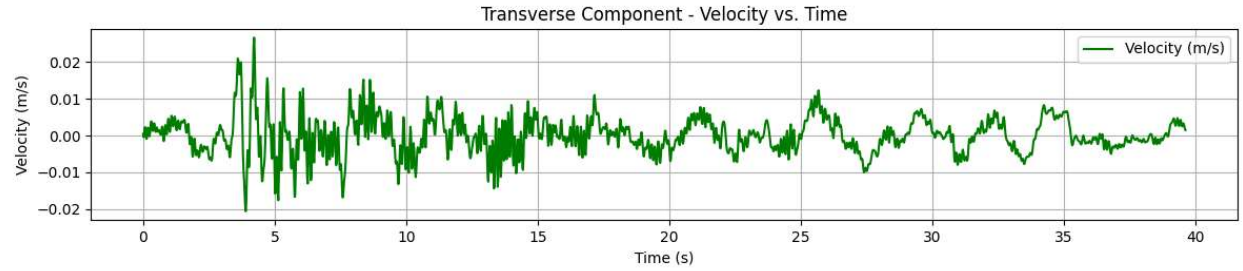
A. ARUDUR Region

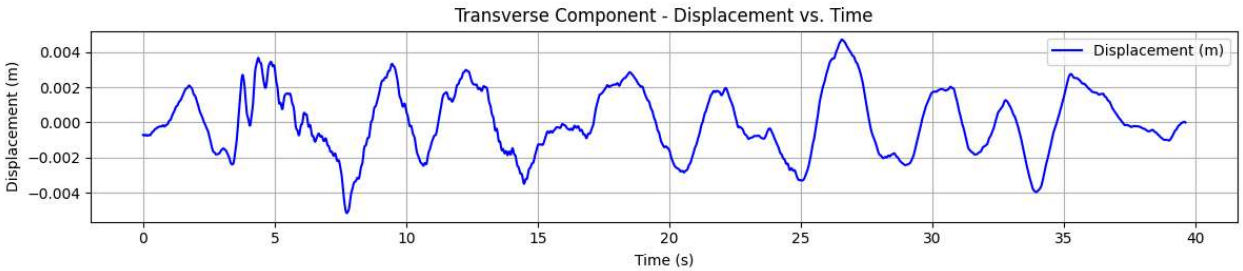
1. Ground Motion Analysis

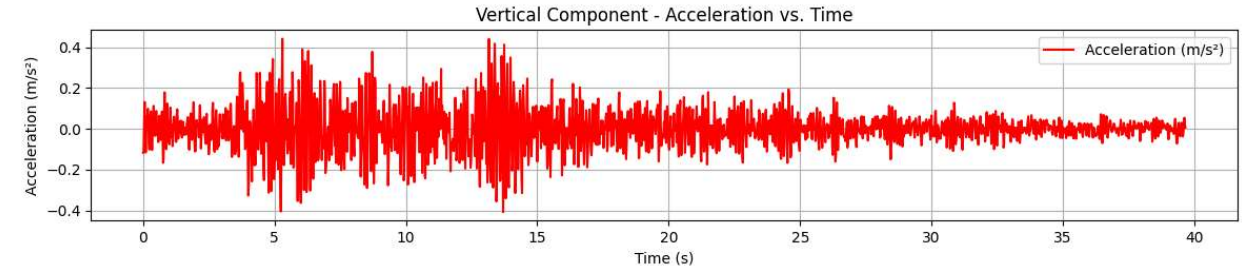
Longitudinal, Transverse, and Vertical Components

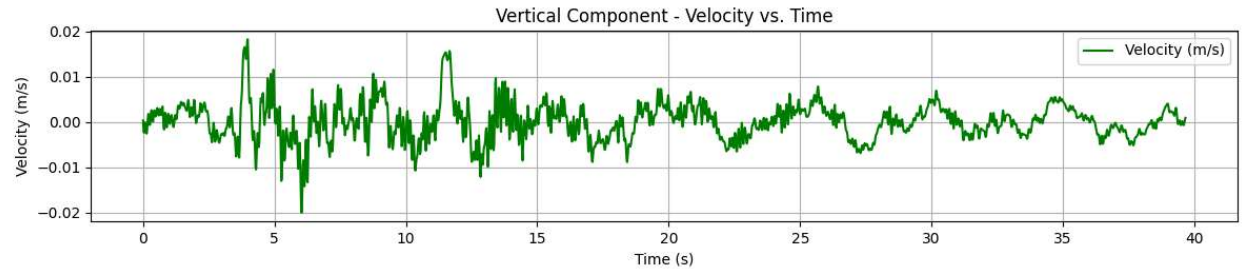


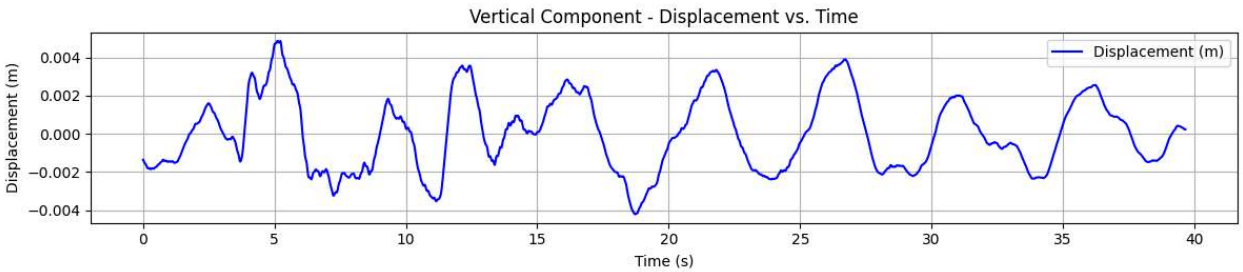

Transverse Component - Acceleration vs. Time
Acceleration (m/s²)
Time (s)


Transverse Component - Velocity vs. Time
Velocity (m/s)
Time (s)


Transverse Component - Displacement vs. Time
Displacement (m)
Time (s)


Vertical Component - Acceleration vs. Time
Acceleration (m/s²)
Time (s)


Vertical Component - Velocity vs. Time
Velocity (m/s)
Time (s)

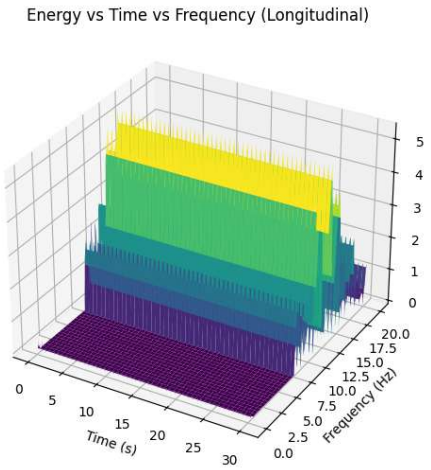

Vertical Component - Displacement vs. Time
Displacement (m)
Time (s)

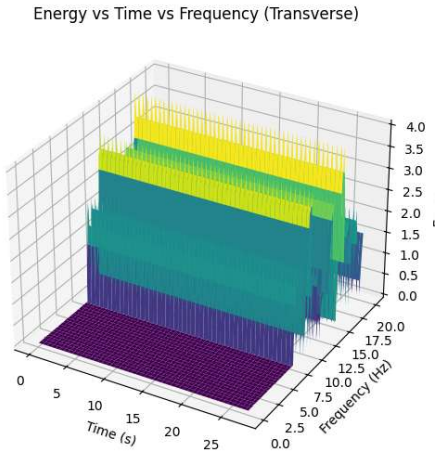
Observations:

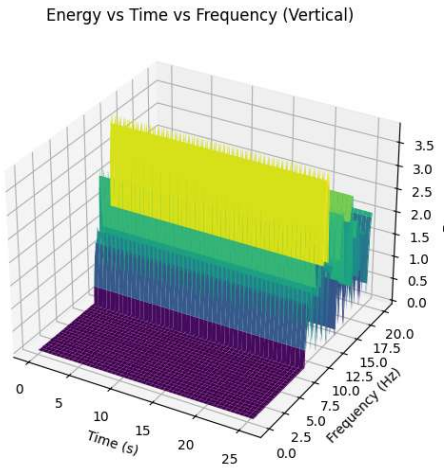
- **Acceleration vs. Time**: The acceleration data shows rapid fluctuations, indicating the intensity of ground shaking. Peaks in acceleration correspond to the strong shaking phases of the earthquake. The longitudinal and transverse components exhibit larger peaks, implying strong horizontal ground motion. The vertical component has relatively smaller fluctuations, as expected in most earthquakes.
- **Velocity vs. Time**: Velocity time series are smoother than acceleration but still show rapid changes, indicating the cumulative motion of the ground. The longitudinal and transverse components exhibit higher velocities, confirming the dominance of horizontal ground motion. The vertical velocity is comparatively lower, meaning vertical ground shaking is weaker than the horizontal motion.
- **Displacement vs. Time**: The displacement plot shows how far the ground moved from its original position. The transverse component exhibits the highest displacement, suggesting a significant sideways shift. The longitudinal component shows moderate displacement. The vertical component displays negative displacement values, indicating sinking or uplift of the ground due to seismic waves.

Peak Ground Acceleration (PGA): is highest in the longitudinal and transverse directions, confirming strong horizontal shaking. **Peak Ground Velocity (PGV) and Peak Ground Displacement (PGD)**: follow a similar trend, with maximum values in horizontal directions. The PGV/PGA ratio suggests the nature of the shaking and the potential for damage.

2. Evolutionary Power Spectral Density (EPSD)



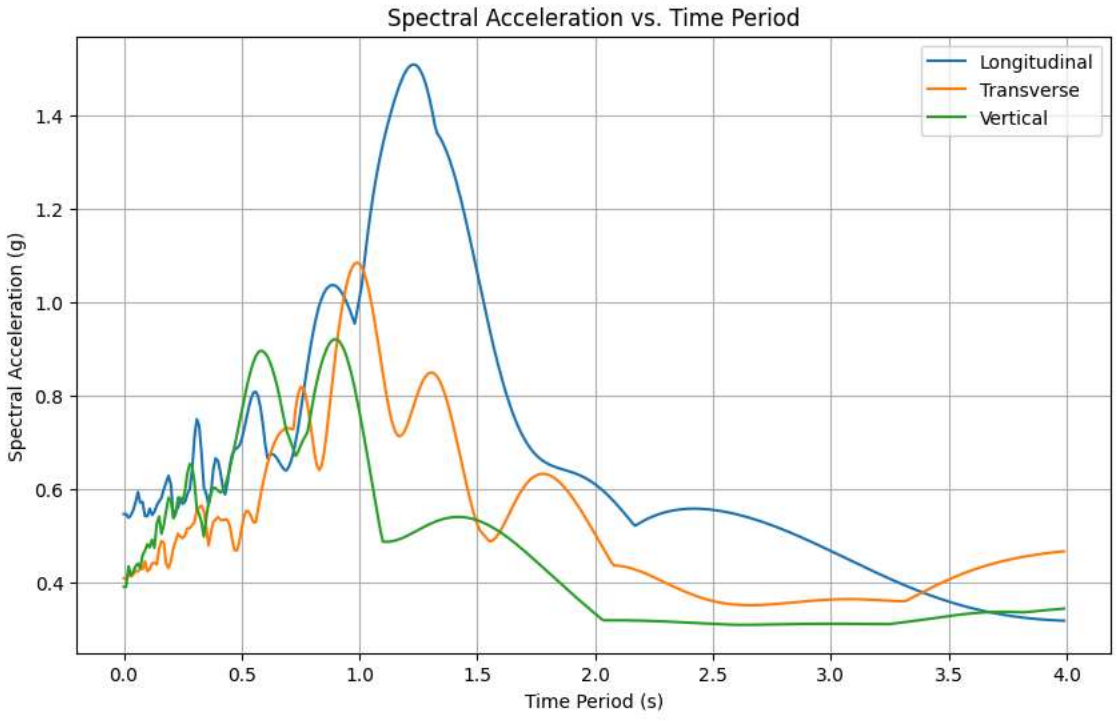




Observations:

- Most seismic energy is concentrated below 5 Hz, characteristic of large-scale seismic events.
- The vertical component has the highest energy density, indicating stronger vertical motion.
- Energy surges at specific time intervals suggest phases of peak ground motion.

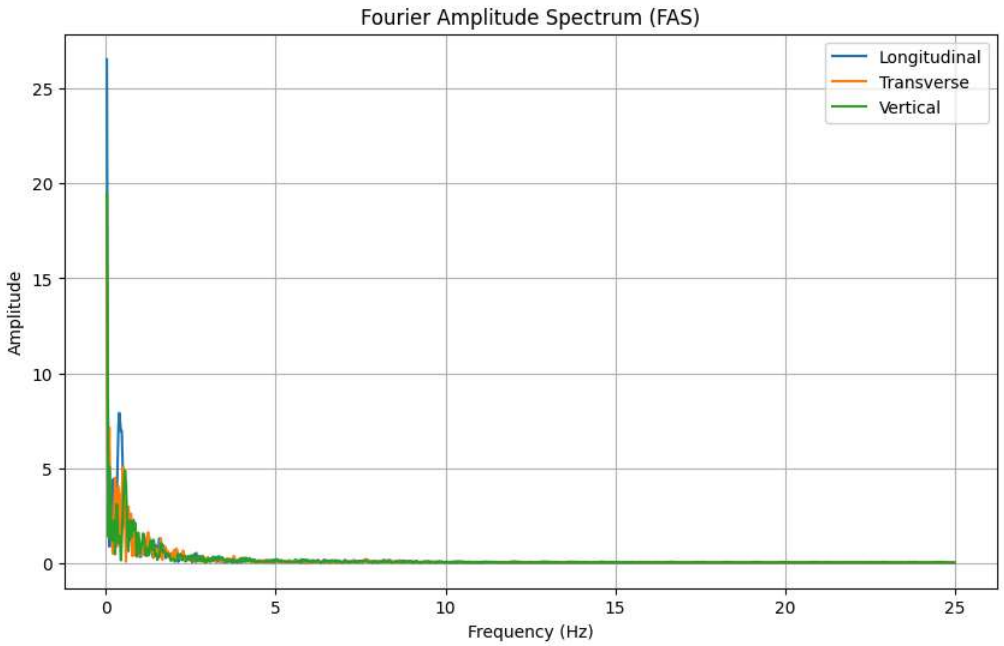
3. Response Spectrum Analysis



Observations:

- Peak spectral acceleration values in the vertical component suggest stronger vertical shaking.
- The longitudinal component exhibits moderate response, stabilizing beyond 1.5s.
- The transverse component displays the least spectral acceleration, indicating lower lateral shaking impact.

4. Fourier Response Spectrum



Observations:

- Low-frequency peaks (<1 Hz) dominate, indicating long-duration shaking.
- Vertical and longitudinal components have higher amplitudes at dominant frequencies.
- The spectral response suggests potential resonance effects on structures.

5. Summary and Conclusion

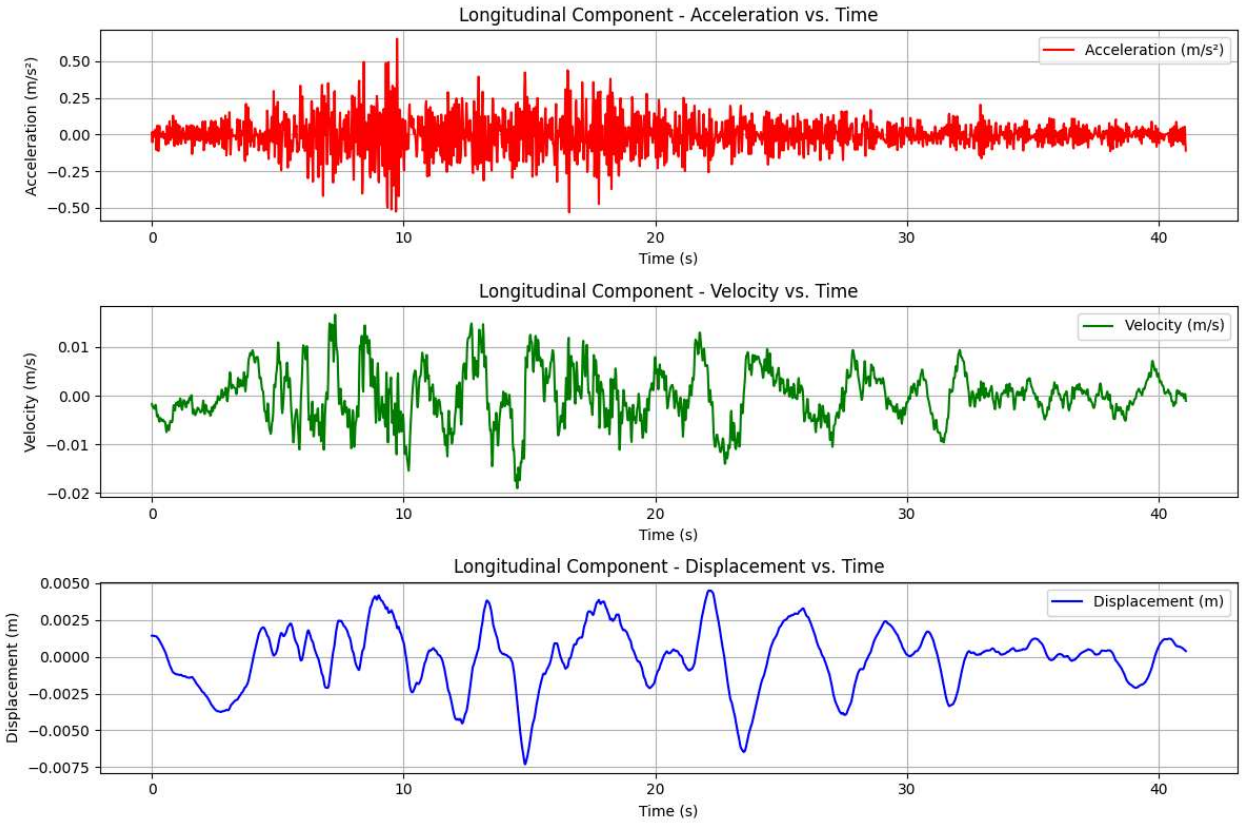
- Vertical motion plays a dominant role in seismic activity across acceleration, velocity, and displacement.
- High-frequency oscillations suggest intense shaking at the onset of the event.
- Displacement trends imply the presence of long-period seismic waves affecting structural integrity.

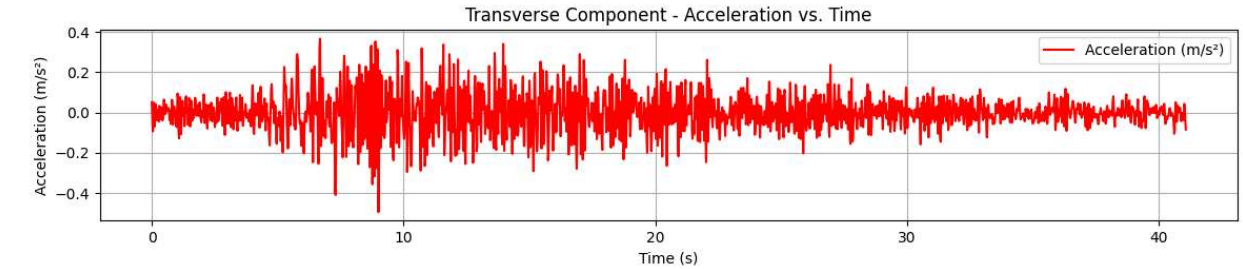
B. Asrin Region

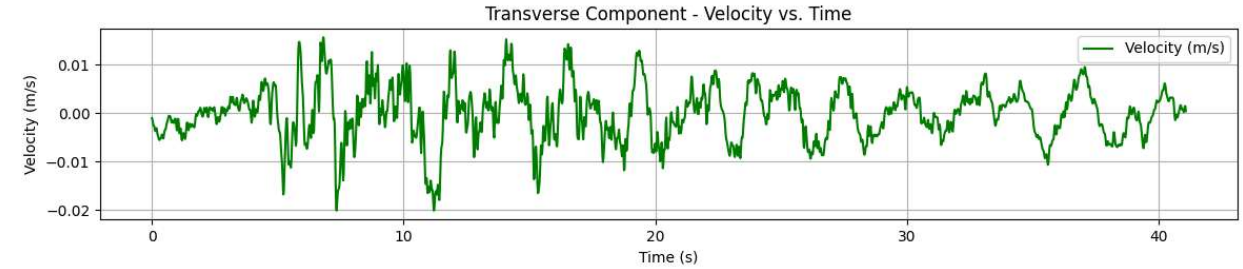
1. Ground Motion Analysis

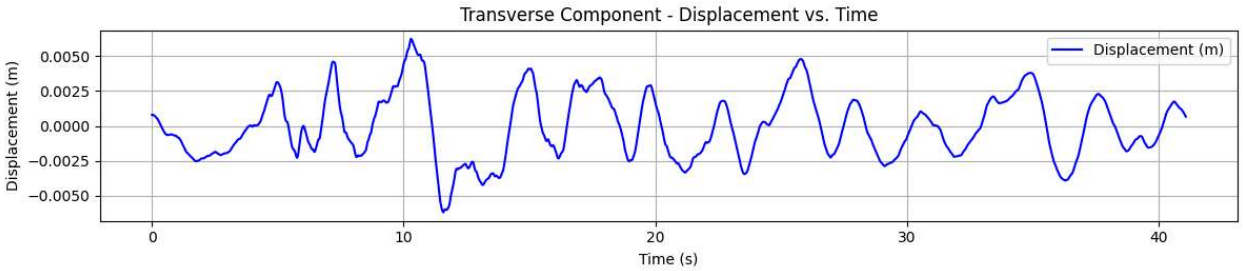
Longitudinal, Transverse, and Vertical Components

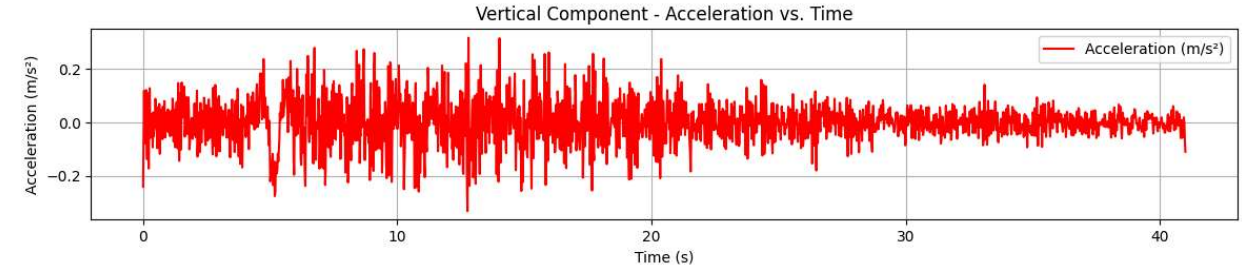
- **Acceleration vs. Time:** Captures initial seismic shock strength.
- **Velocity vs. Time:** Highlights rapid changes in motion due to seismic energy propagation.
- **Displacement vs. Time:** Shows residual ground movement after the event.

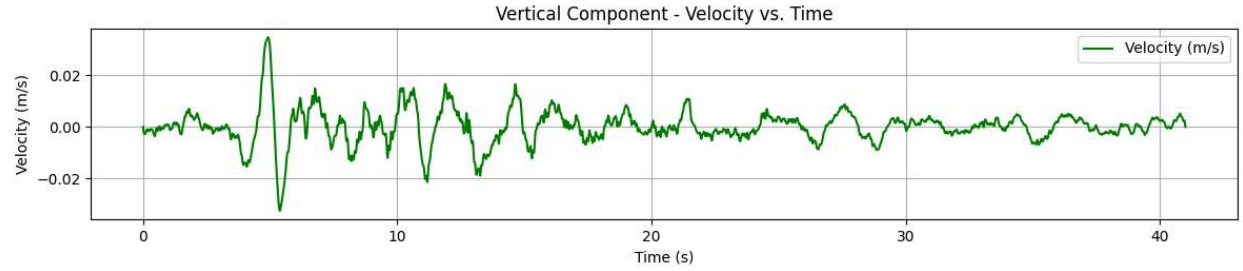


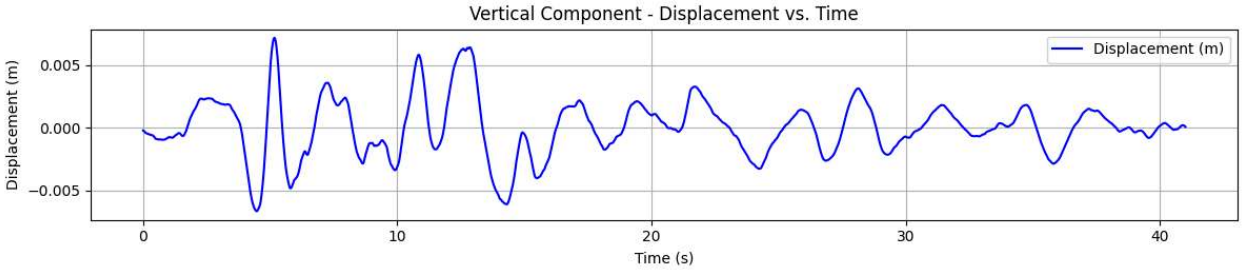

Transverse Component - Acceleration vs. Time
Acceleration (m/s²)
Acceleration (m/s²)
Time (s)


Transverse Component - Velocity vs. Time
Velocity (m/s)
Velocity (m/s)
Time (s)


Transverse Component - Displacement vs. Time
Displacement (m)
Displacement (m)
Time (s)


Vertical Component - Acceleration vs. Time
Acceleration (m/s²)
Acceleration (m/s²)
Time (s)

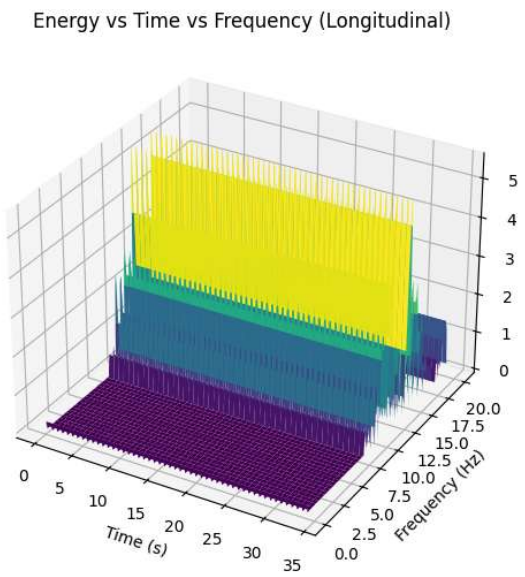

Vertical Component - Velocity vs. Time
Velocity (m/s)
Velocity (m/s)
Time (s)

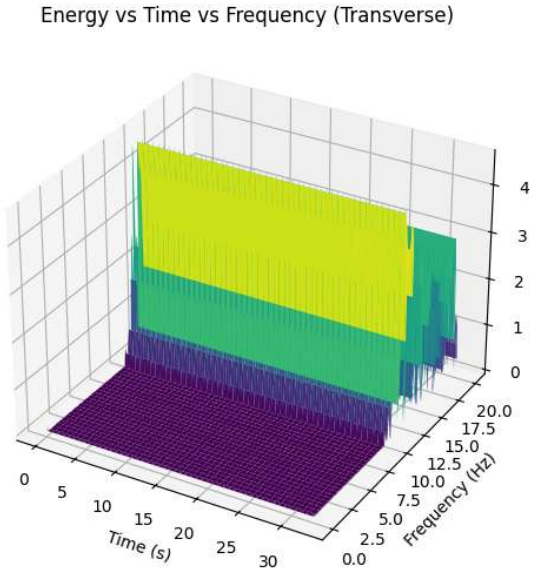

Vertical Component - Displacement vs. Time
Displacement (m)
Displacement (m)
Time (s)

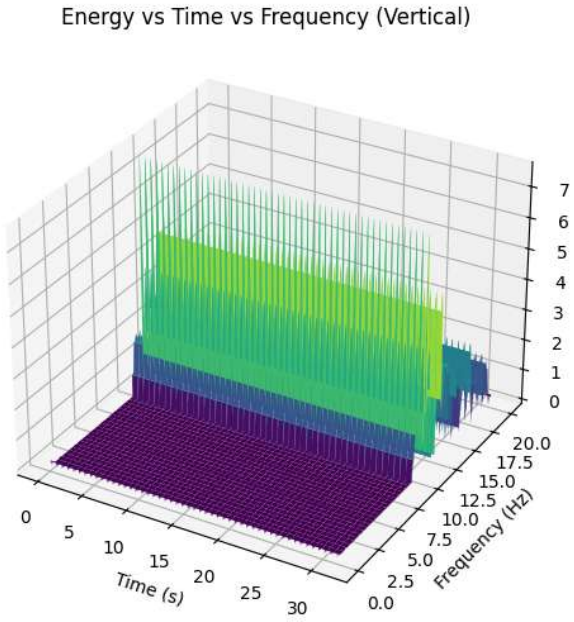
Observations:

- Initial acceleration peaks suggest a strong seismic onset, gradually declining over time.
- Velocity fluctuations are more pronounced in the early phase.
- Displacement patterns indicate the persistence of long-period oscillations post-event.

2. Evolutionary Power Spectral Density (EPSD)





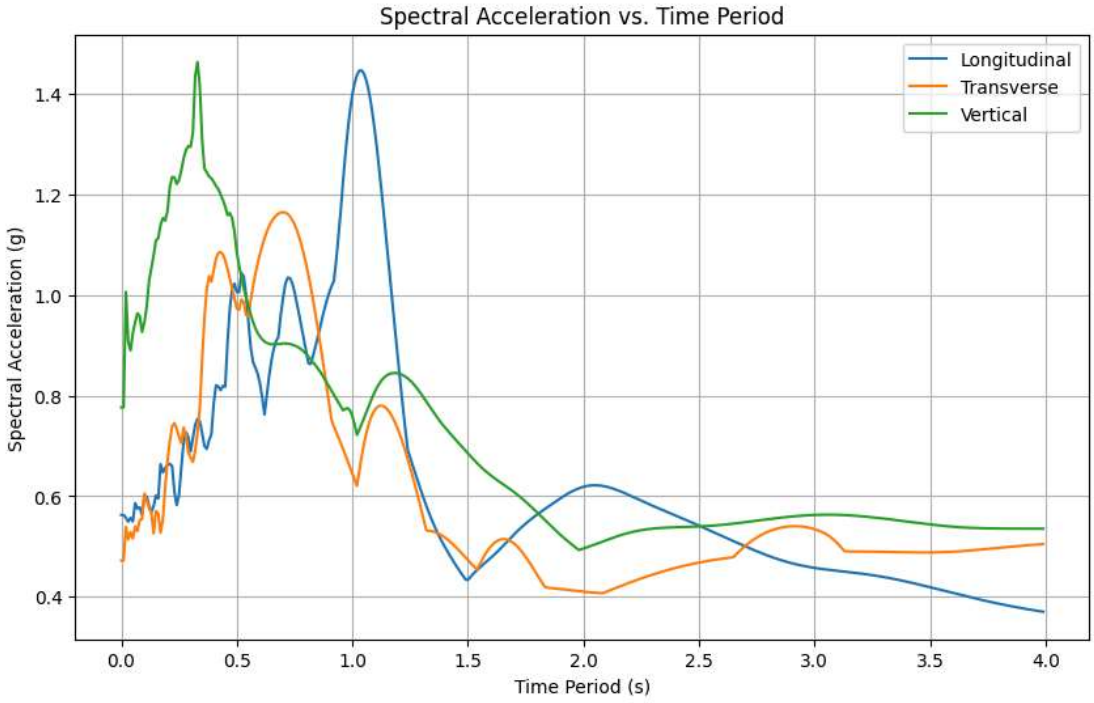


Observations:

- The vertical component exhibits a wider energy distribution, suggesting complex motion behavior.

- Major energy concentration occurs below 5 Hz, consistent with deep seismic activity.
- Energy dissipates significantly after 10 seconds, marking the transition to lower shaking intensity.

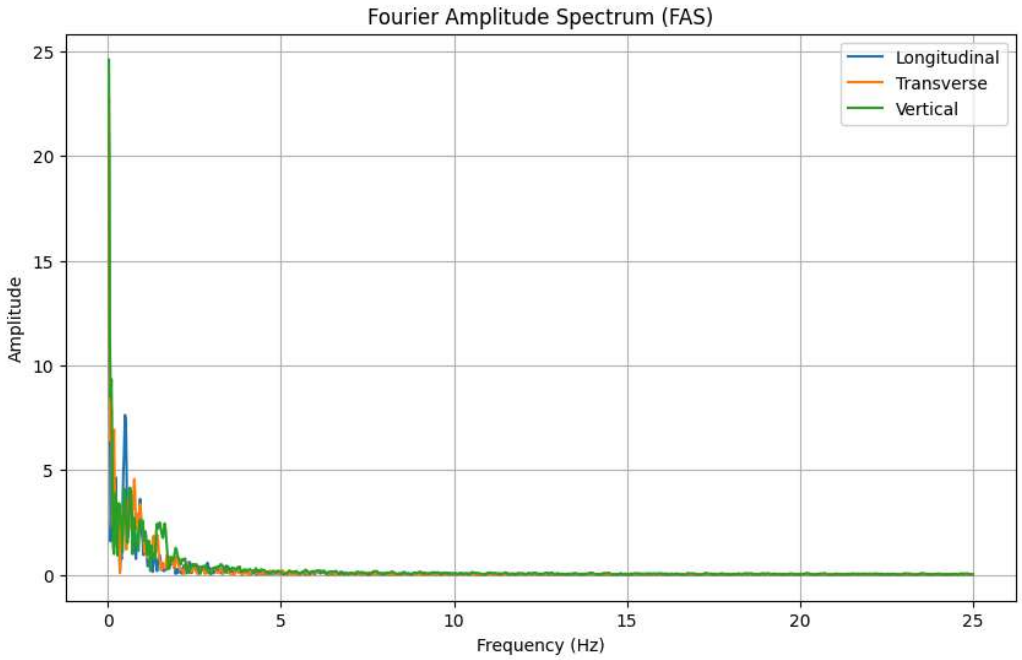
3. Response Spectrum Analysis



Observations:

- Spectral peaks occur between 0.5 to 1.0s, correlating with structural resonance risks.
- The transverse component has the highest spectral acceleration, implying lateral shaking dominance.
- The vertical component's spectral acceleration is significant but stabilizes faster than in ARUDUR.

4. Fourier Response Spectrum



Observations:

- Low-frequency content (<5 Hz) dominates, reinforcing the presence of long-period waves.
- High-frequency components decay rapidly, suggesting reduced impact on high-rise structures.
- The spectral distribution aligns with expected seismic behavior in the region.

5. Summary and Conclusion

- Seismic activity in ASRIN shows strong initial vibrations followed by gradual stabilization.
- Dominant spectral peaks between 0.5–1.0s highlight critical shaking periods.
- The transverse component exhibits the strongest shaking, indicating lateral force prominence.

Code Link

The complete Jupyter Notebook used for this analysis can be accessed from the following link: [https://colab.research.google.com/drive/13vzBFN9pHu3c1U47W85Db8oJH4nTUjQ1?usp=sharing]