Processing and Analysis of Passive Seismic Data Recorded on Campus

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Introduction

- Ambient noise tomography is a seismic imaging technique that uses continuous background noise, rather than earthquakes or controlled sources, to probe Earth's shallow structure
- This method enables the study of surface wave propagation in environments like urban campuses, where traditional active surveys may be impractical
- Generally data recorded with broadband seismometers is used for this
- Using wireless geophones deployed on the IISER Pune campus, we recorded passive seismic data to find local subsurface velocity structure

Methodology

Phase 1:

Raw data → Remove instrument response, remove mean, remove trend, band-pass filter, and cut to length of 1-minute

→ Apply time domain normalization → Apply spectral whitening

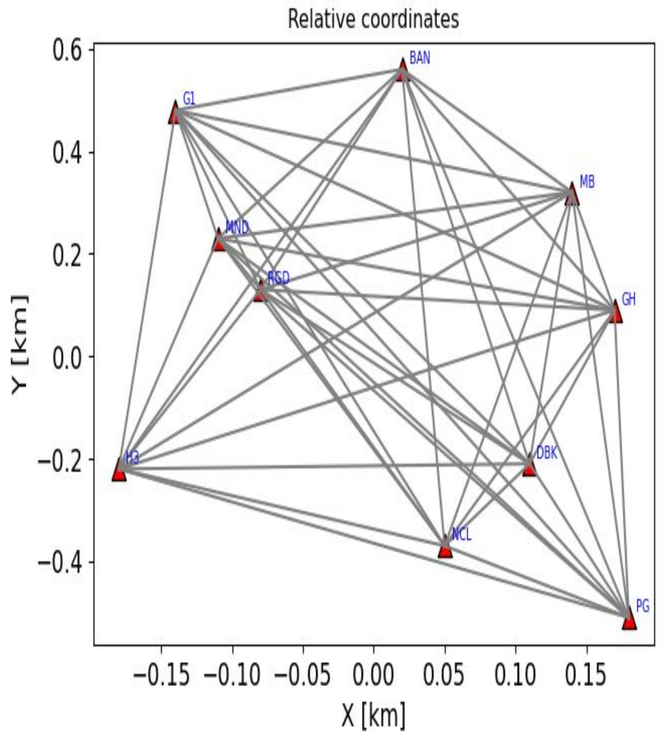
Phase 2:

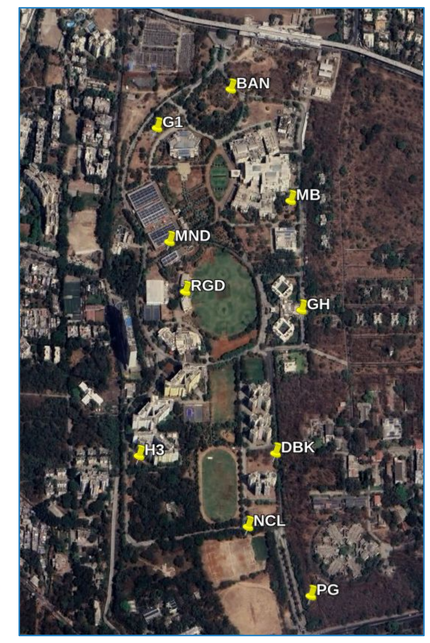
Compute cross-correlation → Stack day-correlations to desired number of days

Phase 3:

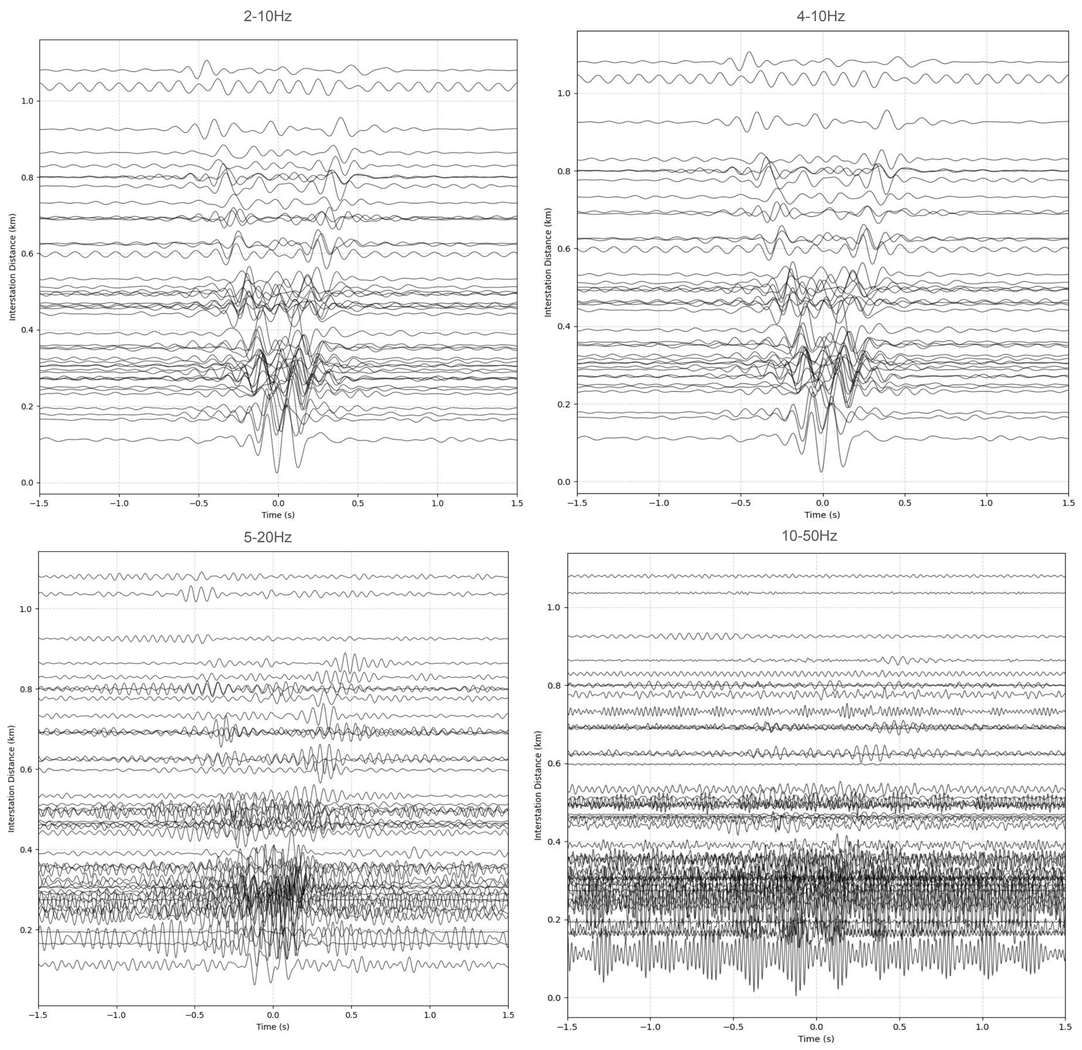
Measure group and/or phase velocity

Map of Stations

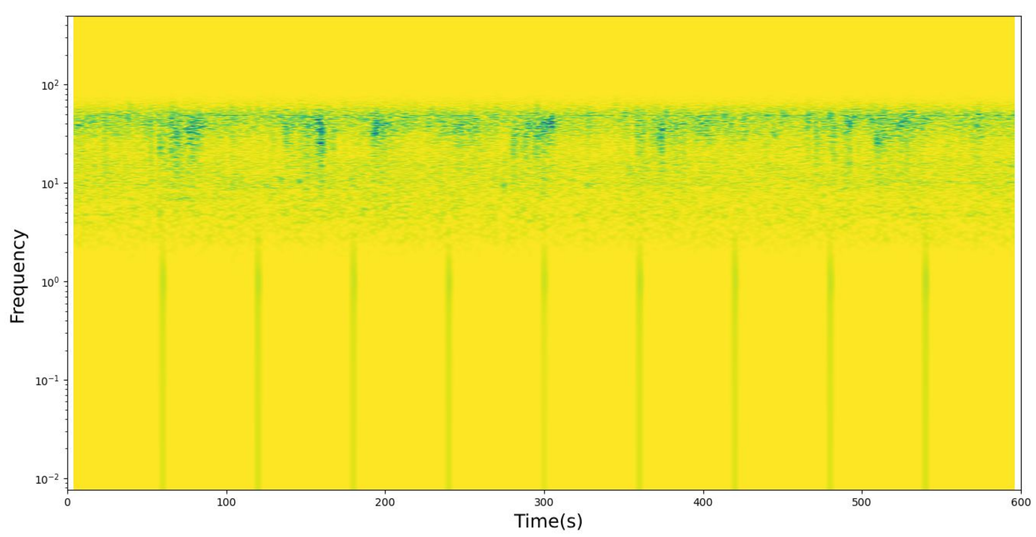




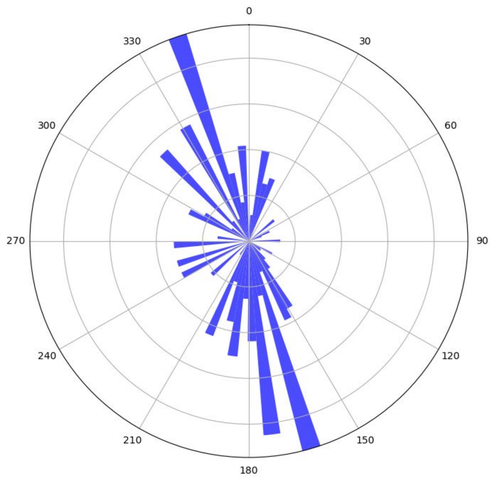
Cross Correlations with Interstation Distance



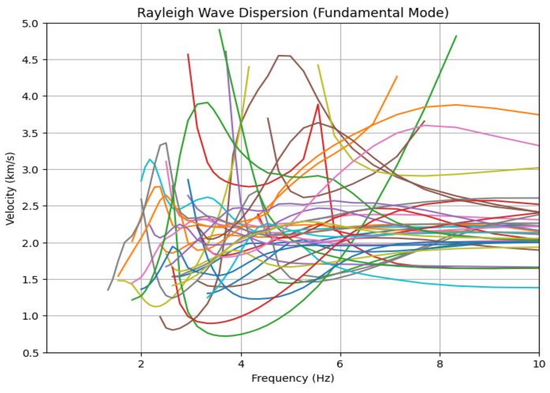
Spectrogram



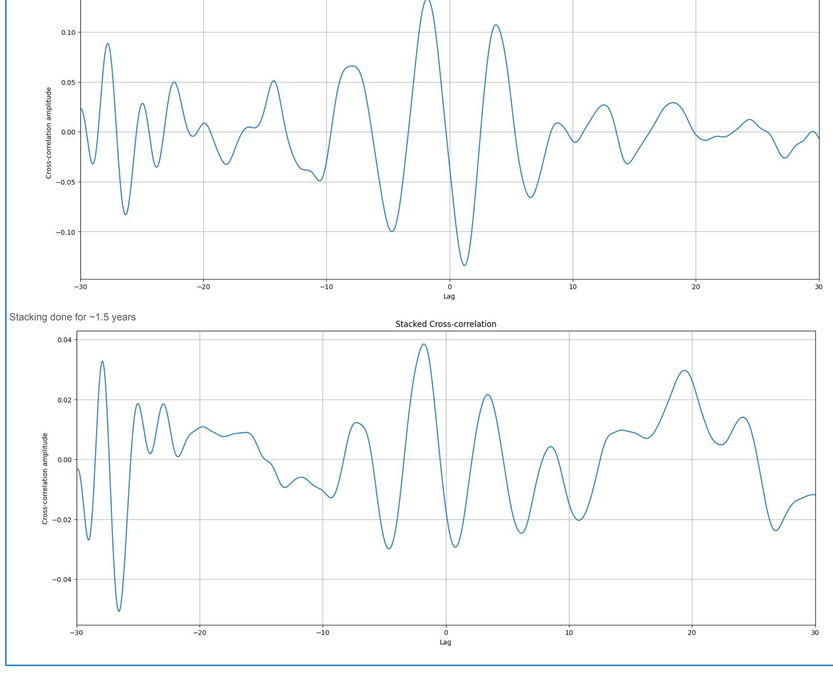
Energy Distribution-Azimuth



Dispersion Curves



Comparison with Deccan Data



- Same pre-processing and cross-correlations was done for 2 broadband stations located 80km apart in the Deccan region
- The frequency range considered for these is between 0.01 and 1 Hz

Conclusion and Future Work

- Trend in the cross correlations indicates the feasibility of usage of geophones even with a small dataset
- Concentration of energy towards 2 main roads indicates most of the noise is from ongoing traffic
- Improve on the dispersion curves with better pre-processing or different frequency range
- Inverting the curves to get a 2D subsurface image of surface velocities

References

- Bensen, G.D. et al. (2007) Processing seismic ambient noise data to obtain reliable broad-band surface wave dispersion measurements.
- Arjun Datta, Shravan Hanasoge, et al. (2019) Finite-Frequency Inversion of cross-correlation amplitudes for ambient noise source directivity estimation.