Application of Seismic Interferometry for Railway Embankment & Soil Monitoring

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Motivation:

The stability of railway embankments is critical for the safety and reliability of rail networks. Variations in soil conditions, such as settlement, erosion, or water content changes, can compromise structural integrity and lead to costly maintenance or failures.

Objectives:

This study aims to explore the use of seismic interferometry (SI) combined with active and passive seismic sources as a non-invasive approach for monitoring soil conditions along railway embankments. The objective is to assess the potential of SI to enhance subsurface imaging and provide early detection of possible instabilities.

Expected Outcomes & Potential Impact:

This study, currently in its processing stage, aims to develop a scalable, non-invasive approach for enhancing subsurface imaging and long-term monitoring of railway embankments. By integrating active and passive seismic data with SI processing, the method seeks to support predictive maintenance and contribute to safer, more resilient rail infrastructure.

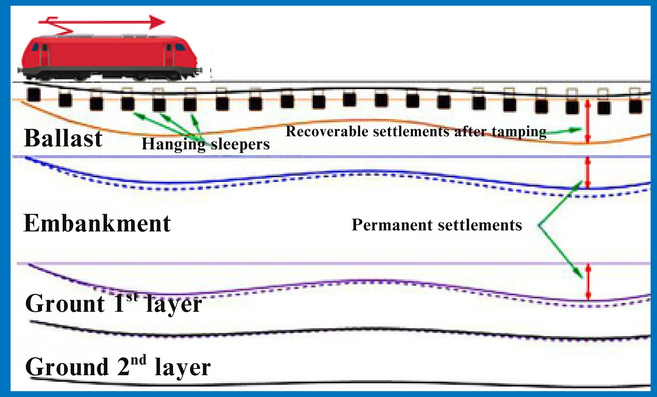
Framework & Methodology:

Active Seismic Sources:

- Controlled sources such as vibrators or hammer impacts.
- Generate high-resolution reflections and surface-wave data.
- Provide a reliable baseline with a high signal-to-noise ratio.

Passive Seismic Sources:

- Utilize natural excitations, including train-induced vibrations.
- Enable continuous data acquisition without interrupting railway operations.
- Complement active-source data with additional wavefield information.



Seismic Interferometry (SI) Processing:

- Cross-correlation of seismic recordings between different receiver pairs.
- Retrieval of virtual-source responses from both active and passive data.
- Enhance imaging capability without the need for physical sources at all locations.

Adaptive Subtraction for active-source data:

- Suppression of dominant surface waves and noise components.
- Improve clarity and resolution of subsurface imaging.

Subsurface Imaging and Monitoring:

- Integration of active and passive data for robust interpretation.
- Enable detection of soil property variations and potential instabilities.
- Support long-term monitoring of railway embankments and surrounding soils.