Center for Sustainable
Future Mobility (CSFM)

REASSESS – Ground penetrating radar for moisture assessment in railway tracks

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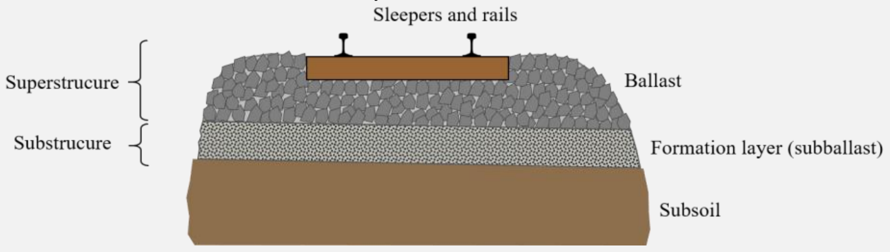
1 Introduction

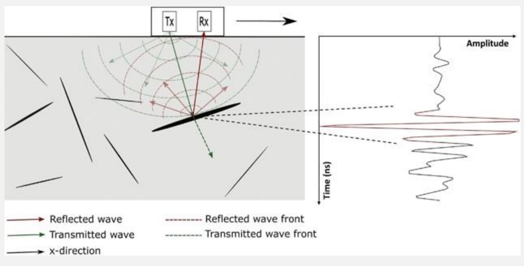
Railway track substructure suffers from water infiltration, resulting in damage linked to moisture accumulation in the ballast and underlying layers. A promising solution for early and accurate detection of such moisture accumulation is found in the use of Ground Penetrating Radar (GPR) technology. In this work, we present a detailed experimental analysis carried out on a controlled railway track section. Our findings demonstrate that GPR systems can effectively detect moisture infiltration in railway tracks, although some challenges are to be addressed for the development of accurate, automated procedures.

2 Background

General structure of a railway track:



A GPR antenna is composed of a transmitter and a receiver. The former sends a signal downwards. Changes in the material reflect a portion of the signal, which is recorded by the receiver.

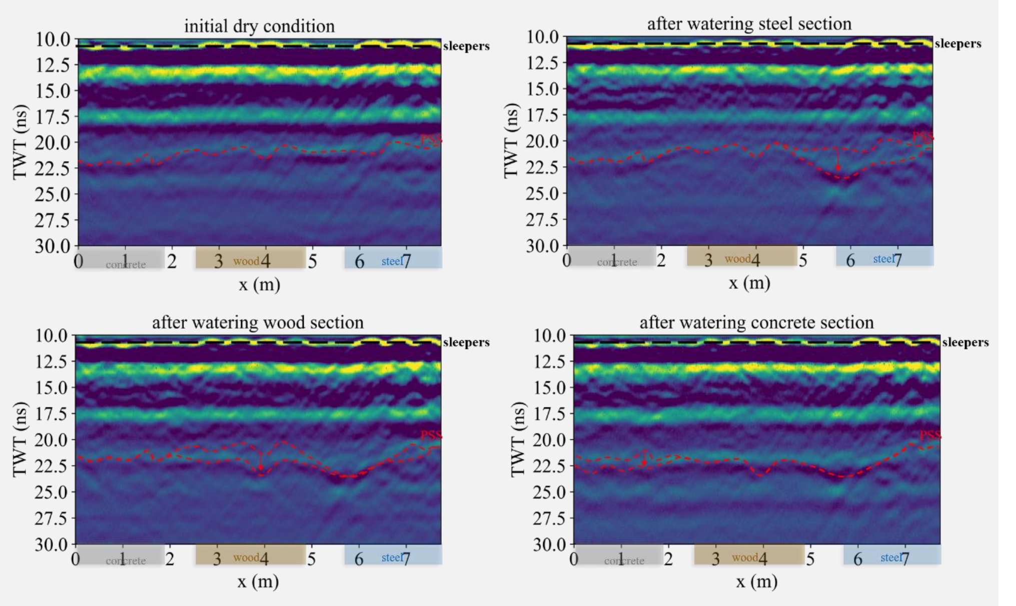


3 Experiment set-up

GPR data is gathered on a test railway track at the initial dry condition and, subsequently, at increasing water contents of the substructure over the steel, wooden, and concrete sleepers. The water content is assessed via ground truth tests in the laboratory on collected samples.

4 Results

After irrigation, the water content of the PSS increases from 3.4~3.8% to 11.7%, 10.4%, and 9% over the wood, steel, and concrete sections, respectively. The higher water content leads to a longer signal travel time. The line of the PSS surface thus appears significantly lowered under each watered section in the GPR measurements.

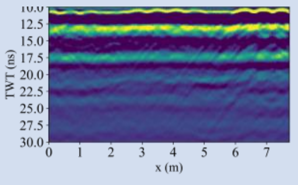


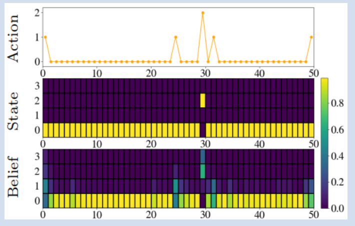
5 Conclusion and future work

- The experimental results demonstrate the potential of adoption of GPR technology for moisture assessment in the track substructure.
- Assessing the water content of the track substructure from a single GPR measurement remains a challenging task, but more observations over time can enable detection of the increase of moisture content.
- Early detection of moisture accumulation in the substructure can thus form a potent tool in support of preventive maintenance actions.
- Future work will focus on the development of a Reinforcement Learning framework for decision support:

On-board GPR monitoring

GPR observations





A RL agent estimates the probable deterioration state and predicts the appropriate action

References

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