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Subgrade Deformation Detection Using Newly Developed Piezo Sensors

Adjetey Rufus Nii-Adjei
Prof N. Thom, Prof G. Airey, Prof A. Dawson

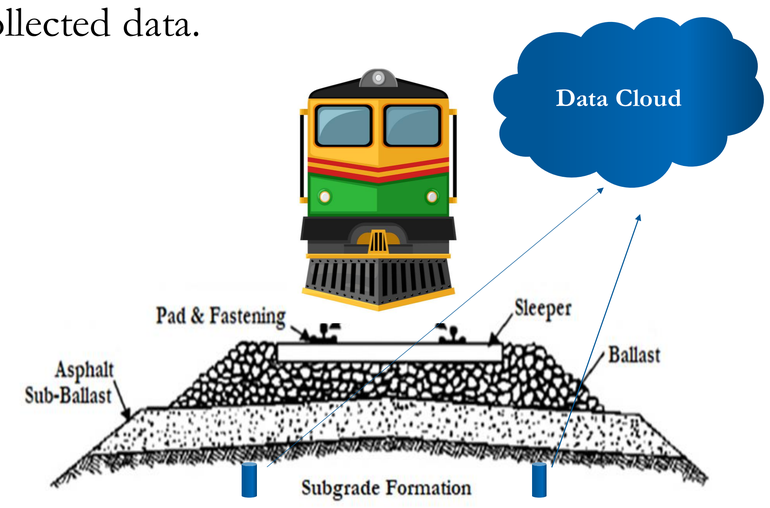
INTRODUCTION

The subgrade is a crucial trackbed layer which may fail due to repeated loading, inadequate bearing capacity and changes in its moisture content. Hence it is important to monitor the rate of deterioration of the trackbed to help maintenance teams prevent track failures. Over the years, traditional techniques which include coring through ballasts using Automatic Ballast Samplers and the use of penetrometers for extended trial holes to investigate the underlying material have been common. Also, non-destructive testing techniques such as the Falling Weight Deflectometer and the Ground Penetrating Radar are currently being used. These provide variation of track properties along the track. However, these techniques are expensive and cause downtime to the track.

It would therefore be useful to provide low-cost health monitoring techniques for the subgrade using sensors. These sensors harvest energy from the railway environment to monitor and collect damage data continuously in real time in order to inform railway engineers planning to take maintenance actions.

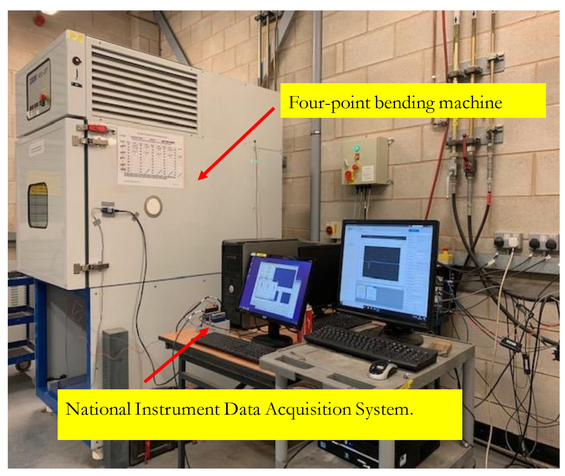
AIMS

- Develop a low-cost self-powered sensor for continuous and autonomous sensing to monitor deformation in soft subgrade soils under repeated loading and harsh environmental conditions.
- Develop a sensor-specific data algorithm for track maintenance from collected data.

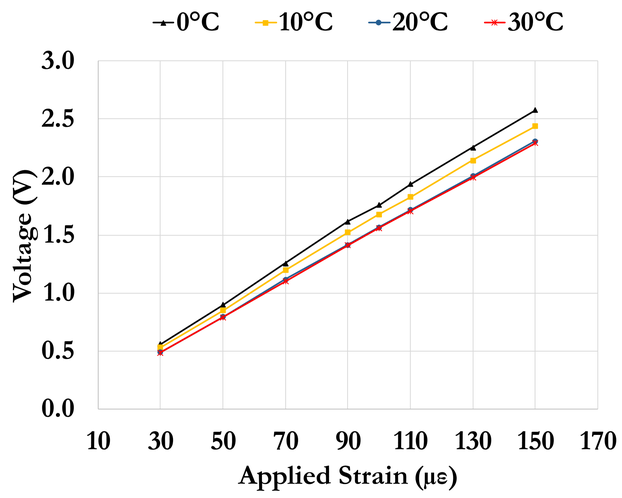


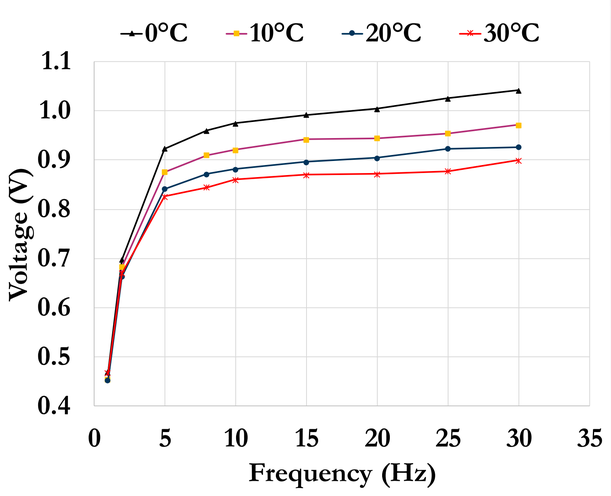
METHODOLOGY

- PHASE I: Calibration of piezoelectric transducers under the influence of strain, temperature and frequency of loading using a Four-Point Bending Testing machine.

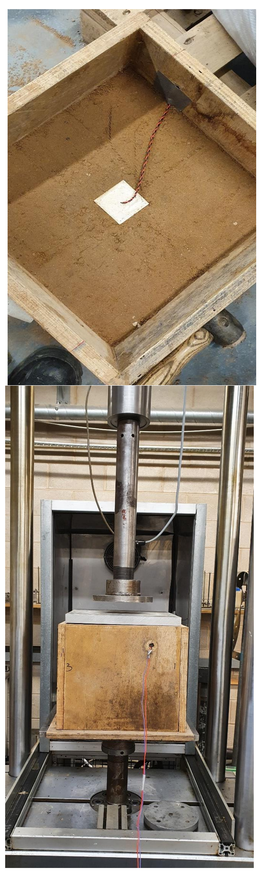


PHASE I RESULTS

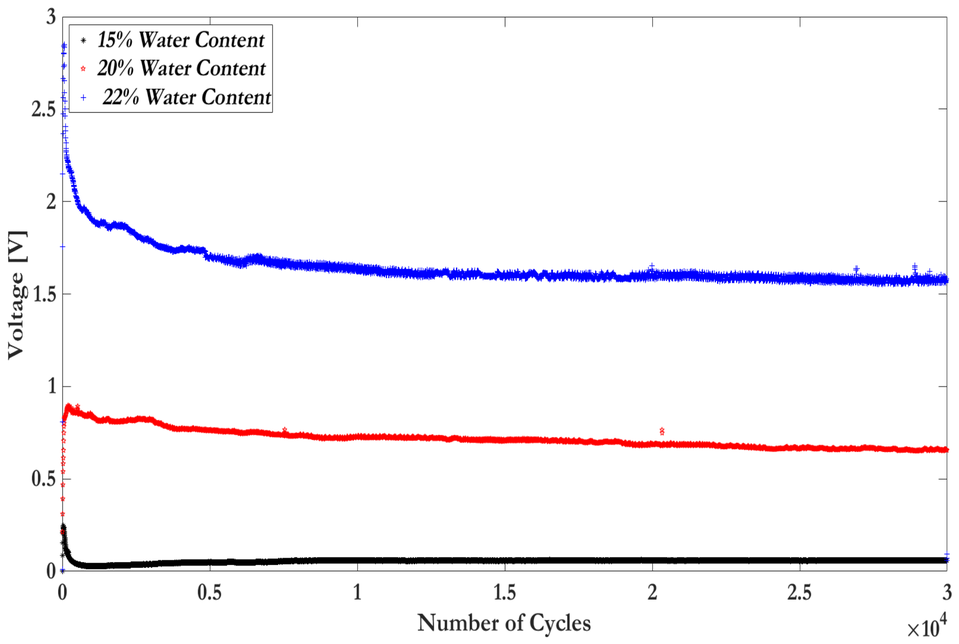




- PHASE II: Laboratory calibration of designed prototype gauge using the Ballast Box.



PHASE II RESULTS



- PHASE III: Field calibration of prototype gauge

CONCLUSION

- Reliable readings have been obtained from the gauge.
- Different subgrade materials will be tested under different water content levels and loading levels to calibrate the newly developed sensor.
- Installation and testing of gauge on a test track to calibrate sensor.

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