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MONITORING OF RAILWAY TRACKS USING VEHICLE-MOUNTED SENSORS AND DIRECT INTEGRATION

Jennifer Keenahan [1], Eugene J. OBrien [2] and Yifei Ren[3]*

[1] UCD School of Civil Engineering, University College Dublin, Newstead, Belfield, Dublin 4, Ireland, jennifer.keenahan@ucd.ie
[2] UCD School of Civil Engineering, University College Dublin, Newstead, Belfield, Dublin 4, Ireland, eugene.obrien@ucd.ie and http://www.ucd.ie/research/people/civilengineering/professoreugeneo'brien/
[3] UCD School of Civil Engineering, University College Dublin, Newstead, Belfield, Dublin 4, Ireland, ren.yifei@ucdconnect.ie

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Railway tracks can be monitored by visual inspection or indirectly using inertial sensors installed in a passing vehicle. Defects in the track such as depressions in the profile or points of low stiffness (e.g. hanging sleepers) interact dynamically with passing vehicles and can be detected with accelerometers and gyrometers. This can be achieved using special purpose track recoding vehicles or through instrumentation of regular trains in service.

It has been shown in previous research that track profiles can be back-calculated from vehicle-mounted sensor data using an optimisation procedure. This involves finding the profile that gives a best fit to the measured data. In this paper, a new direct integration approach is introduced to directly calculate the track profile from the accelerations and rotations. An adaptation of the Newmark Beta numerical method is used for this purpose. Compared with the profile calculated using the optimisation algorithm, the results are similar. However, direct integration is much more efficient than optimisation and allows the calculation to be completed in a fraction of the time. Both methods can only capture short wavelength changes in profile – the numerical inaccuracies tend to accumulate which results in a 'drift' in the calculated profile over time/distance. This is not considered to be a significant issue as track damage or deterioration is generally evident over short lengths.

In this paper, the direct integration approach is demonstrated in numerical processing of field measurements taken from an in-service railway carriage. Then, a railway carriage model was calibrated using approach optimisation despite some uncertainties and variations between runs in the vehicle weight. While the true profile under load was unknown, the results were plausible and an area where the track foundation is known to be poor (over peat soil) was successfully identified.