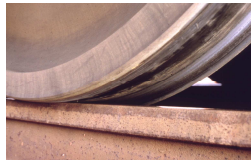


An optimised wheel-rail contact model for vehicle dynamics simulation



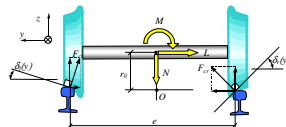
Researcher: Philip Shackleton

Background:



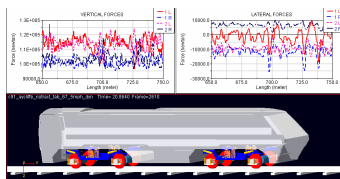
It is a plausible assumption that railway wheels and rails are designed solely to allow vehicles smooth and efficient rolling. However on closer inspection, the wheel-rail interface proves to be an essential part of the dynamic system which governs the motion of a railway vehicle.

Far advanced from early wheel-rail concepts, where cylindrical wheels were guided along a flanged track, modern designs use complex profiles for both wheel and rail, chosen for their influence on the overall dynamic system behaviour and their wear and rolling contact fatigue (RCF) characteristics.



Problem:

Computer packages using multi-body dynamics (MBD) are used to simulate the dynamic performance of railway vehicles, from the design stage through to accident investigation, and increasingly simulation data is used in the evaluation of contact problems such as wear, rolling contact fatigue and roughness growth. All MBD packages make simplifications when simulating the wheel-rail contact to allow the analysis



to be completed in an acceptable time; the fastest commercial package runs slightly faster than real-time while others run 10s of times slower. The effects of these simplifications on the validity of results is not well understood.

It has been shown that, for certain contact cases, there can be large discrepancies between the outputs of different contact models. Where, for instance, contact patch stress distributions are of importance, such as in the investigation of RCF or wear prediction, such errors could lead to inaccurate conclusions and may also have undesirable implications for the overall, dynamic model.

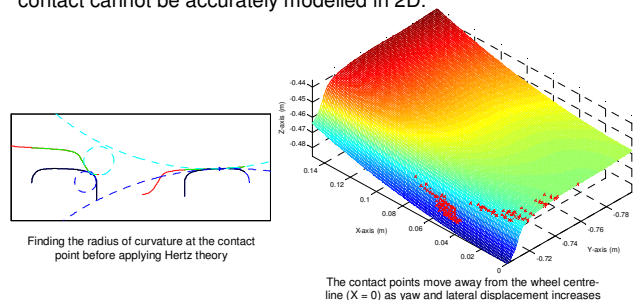
Method:

- Identify current methods and approaches for modelling wheel/rail contact.
- Determine the scope and limitations inherent in those methods and approaches.
- Establish a benchmark to compare the performance of contact models in the context of MBD simulation.
- Summarise the results of the benchmark, focusing on the validity of contact patch data and the extents to which validity can be ensured.
- Produce an optimised contact model(s) that will offer improved performance through diverse test situations and simulation requirements.

Progress:

A comprehensive literature survey has been undertaken covering current wheel/rail contact theory and modelling methods.

A new method has been developed to find the contact position, contact angle and rolling radius difference for a wheelset with given lateral displacement. This code has been developed in 2D and 3D versions, the former allows for a faster simulation, while the later can take account of high yaw values, where the contact cannot be accurately modelled in 2D.



A wheel/rail contact benchmark is underway to evaluate the influence of different contact modelling assumptions, on a dynamic vehicle model. The first part of the benchmark, Case A, has received significant contributions from industry and researchers. Details about this benchmark can be found at www.rtu.mmu.ac.uk

Contact:

Name
Mailing Address

Philip Shackleton E-mail: p.shackleton@mmu.ac.uk
Department of Engineering and Technology, John Dalton Building
Manchester Metropolitan University, Chester Street, Manchester. M1 5GD