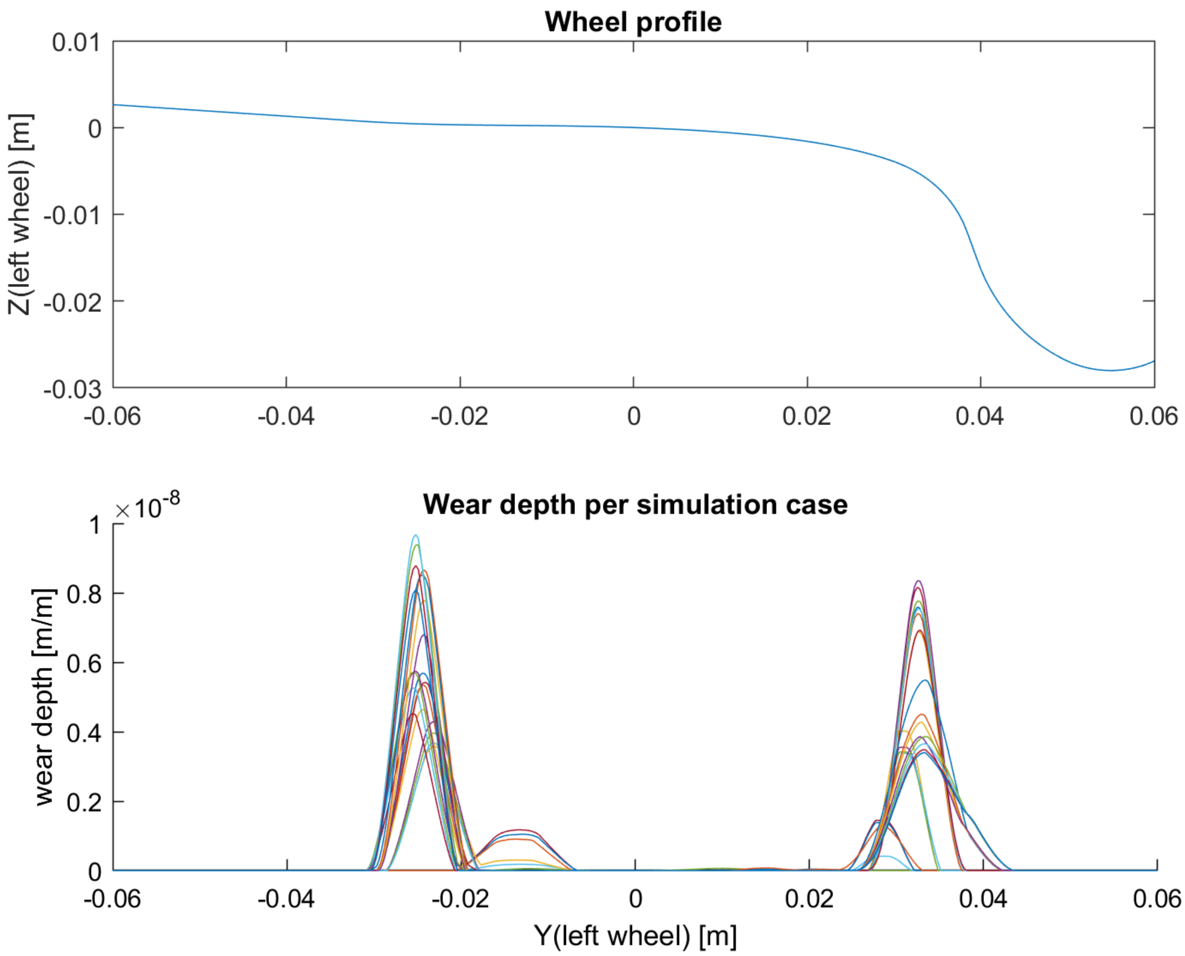
Implementation of novel wear prediction methodology for damage calculation in rail vehicles



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Introduction

Rail stakeholders have a genuine concern about wheel and rail wear, due to the influence of worn profiles in the cost of vehicle and track maintenance. Wear prediction methodologies have existed for about two decades now but prediction methodologies takes a long computational time. Recently, a novel prediction methodology has been published which substantially cuts down the simulation time, based in two assumptions :

1. It uses quasi-static simulations instead of dynamic simulations.
2. The track geometry is simplified in a two-dimensional workspace, allowing the interpolation of the wheel wear values of all track sections with some selected characteristic points (CP).

The objective of this work is to implement the methodology in Matlab and the multibody simulation software (GENSYS), run simulations and compare wear calculation results with published cases (see Figure 1).

Method

Due to computational cost it is usually not possible to simulate the whole track network. Therefore the characteristic point method provides a set of simulation cases, the characteristic points which represent the track network.

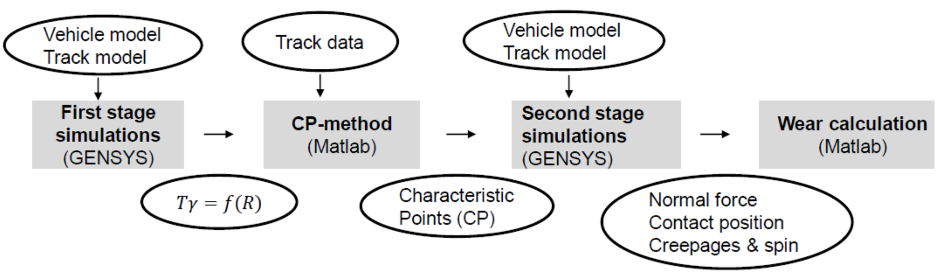

Figure 1: Work flow of the methodology

The required inputs are the vehicle model, the track model and ideal track data with radius, element length and cant. The speed is assumed to be distributed around the maximum speed of the track sections. The multibody simulations are run with a numerical integration in time domain (TSIM) in GENSYS on ideal track. Wear is calculated with Archard's formula. In order to simplify the implementation, wear is calculated only for one step of a full wear calculation without wheel profile updating.

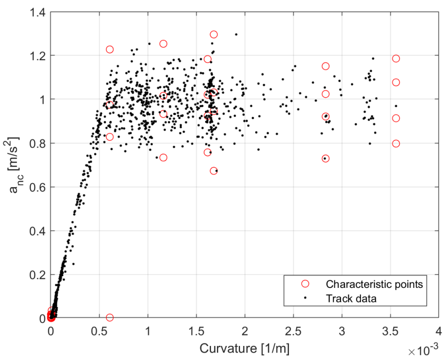

Figure 2: Track data and characteristic points plotted in the non-compensated acceleration/ curvature space

Results

The wear calculation is provided in wear per rolled meter. The total wear depth in Figure 3b) has two peaks, one at the wheel tread and one at theflange. Small radius curves have 100 times higher wear depth than the tangent track. Therefore the small radius curves have the highest influence on the total wear depth.

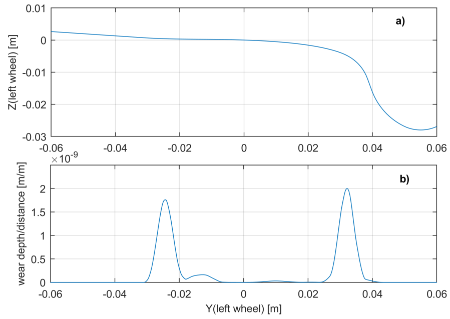

Figure 3: a) Wheel profile. b) Wear depth

Conclusion

It is important to have a good knowledge of the real operation conditions for the assumption of the speed. Further research should run full wear calculations with profile updating and realistic operation situations to validate the results with wheel profile measurement data.

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