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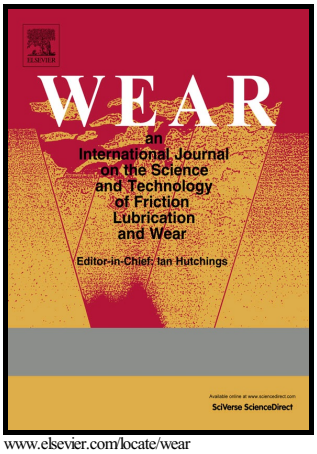

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A fast wheel-rail contact model for application to damage analysis in vehicle dynamics simulation

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Abstract

A novel wheel-rail contact model is proposed to be implemented for multi-body dynamics simulation, in order to facilitate accurate online calculation of damage phenomena such as wear and rolling contact fatigue. The normal contact, i.e. contact patch and pressure distribution, is calculated using a fast non-elliptic algorithm called ANALYN. The tangential contact, i.e. tangential stress distribution, stick-slip division and creep force calculation, is treated using an alternative to the FASTSIM algorithm that is based on a strip theory which extends the two-dimensional solution of rolling contact to three-dimensional contacts. The proposed contact model is compared to the Hertz+FASTSIM model and evaluated using the CONTACT code in terms of contact patch and stress distribution as well as creep force curves. The results show that the proposed model can significantly improve the estimation of the contact solution both in terms of creep force estimation and contact details, such as stress distribution, needed for damage predictions.

Keywords:
Wheel-rail contact, Rolling contact, Vehicle dynamics simulation, Damage, FASTSIM

1. Introduction

The maintenance cost due to damage of wheels and rails has raised the urge to predict deterioration phenomena such as wear and rolling contact fatigue using simulations. To conduct such predictions accurately, a good estimation of contact patch and the stress distribution within it is needed.

In multi-body simulation (MBS) codes used for dynamic simulation of rail vehicles the contact forces within each wheel-rail interface have to be calculated at every time-step. This restricts the computational demand of the wheel-rail contact model in use. Therefore, a rigorous calculation such as the one offered by the CONTACT code [1] is not affordable, when long distance simulation (as needed for wear calculations, for instance) is intended.

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