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PREDICTION OF WHEEL AND RAIL PROFILE WEAR ON COMPLEX RAILWAY NETS

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The prediction of wheel and rail wear is a fundamental issue in the railway field, both in terms of vehicle stability and in terms of economic costs (wheel and rail profile optimization from the wear viewpoint and planning of maintenance interventions).
In this work the Authors present a model for the evaluation of the wheel and rail profile evolution due to wear specifically developed for complex railway nets.
The layout of the new wear model is made up of two mutually interactive but separate units: a vehicle model for the dynamical analysis and a model for the wear evaluation (Figure 1). The first one consists of two parts that interact online during the dynamic simulations: a 3D multibody model of the railway vehicle (implemented in SIMPACK) and an innovative 3D global contact model for the detection of the contact points between wheel and rail and for the calculation of the forces in the contact patches (implemented in a C/C++ user routine of SIMPACK). [1][2][3][4][5]

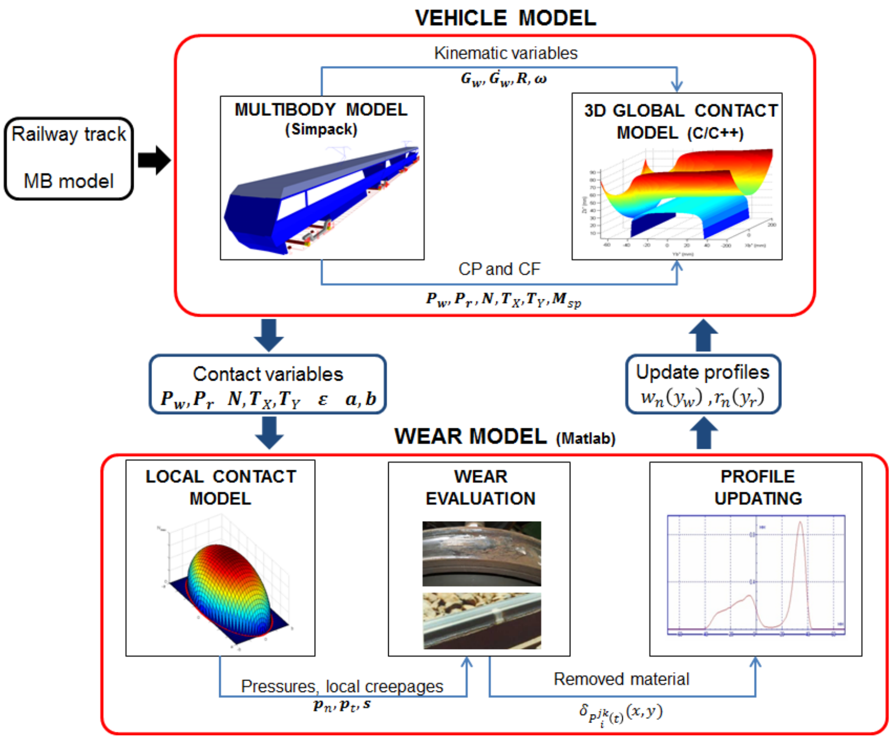

Figure 1. Layout of the model

The wear model (entirely implemented in MATLAB) starts from the outputs of the dynamic simulations (position of contact points, contact forces and global creepages) and calculates the pressures inside the contact patches through a local contact model (FASTSIM algorithm); then the material removed by wear is evaluated (by means of experimental laws correlating the friction power produced by the tangential contact forces and removed material by wear) and the worn profiles of wheel and rail are obtained. [3][7]
If complex railway nets have to be studied, the exhaustive simulation of the vehicle dynamics and of the wear evolution on all the railway net turns out to be too expensive both concerning computation times and memory consumption and concerning the availability and the collection of the experimental data needed for model validation. For this reason, to overcome these limitations, the Authors developed a new statistical approach to achieve general significant results in a reasonable time; in particular the entire considered railway net has been substituted with an equivalent set of different curved tracks (classified by radius, superelevation and traveling speed) and statistically equivalent to the original net. At this point the dynamical simulations are not performed on the real railway net anymore but directly on the equivalent representation of the net derived by means of statistical methods. [6]
To evaluate the accuracy, the numerical efficiency and the sensitivity to parameters of the new approach, the results obtained from the exhaustive simulations performed on all the railway net have been compared to those achieved on the set of curved tracks statistically equivalent to the net. Both the exhaustive and the statistical approaches have been validated in collaboration with Trenitalia S.p.A. and Rete Ferroviaria Italiana (RFI), which have provided the technical documentation and the experimental results relating to some tests performed with the DMU Aln 501 Minuetto vehicle on the Aosta-Pre Saint Didier railway line.

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