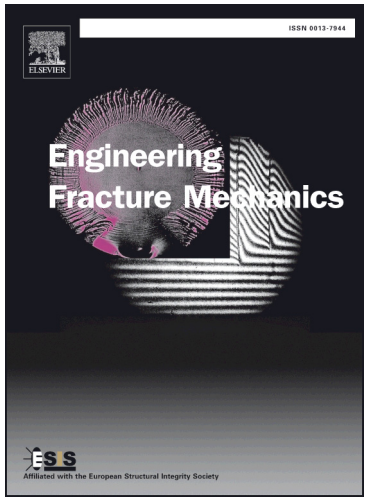


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# Numerical simulation of rolling contact fatigue crack growth in rails with the rail bending and the frictional contact

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***ABSTRACT.***

*Due to the repeated passages of the wheels, the rail is subjected to time-dependent, multiaxial, non-proportional, mixed mode cyclic loading. Under these conditions of loading, the fatigue cracks can appear in the surface or subsurface of the rails. This paper attempts to investigate the multiaxial fatigue crack growth in rails using 3D numerical simulations taking into account the frictional contact between crack faces and the rail bending. Firstly, a quick description is given of the two-scale strategy (global structure and local interface) for the cracked body problem with frictional contact between the crack faces. In this strategy, a stabilized three-field weak formulation is proposed to avoid possible oscillations in the local solution linked to the LBB condition. This formulation is discretized within the framework of the eXtended Finite Element Method (XFEM). Then, the LATIN non-linear solver is used to solve the two-scale problem. Secondly, we focus on the 3D railway track model with an initial crack on the rail surface. The sleepers and the rail fastenings are modelled by introducing constraints on the vertical displacement of some nodes on the rail foot. This 3D cracked rail model is used to simulate the propagation of different types of crack (in curve, in straight line) under the multiaxial wheel-rail contact loading. Finally, a parametric study is investigated in order to clarify the influence of the friction coefficient between crack faces, the position of the crack in relation to the sleepers and the stiffness of the track on the crack growth behavior.*

*Keywords: XFEM, Rolling contact fatigue, crack growth, rail bending, frictional contact*

**NOMENCLATURE**