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WEAR MODELLING in ELASTO-PLASTIC WHEEL-RAIL CONTACT PROBLEMS

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This work is concerned with the thermomechanical numerical procedure to solve the wheel–rail contact problem and computes the distribution of surface flash temperatures, stresses as well as the wear evolution due to friction [1,2].
The two-dimensional wheel-rail contact problem between a rigid wheel and an elasto-plastic rail lying on a rigid foundation is considered. The contact phenomenon includes Coulomb friction, frictional heat generation as well as the wear of the contacting surfaces. The displacement and stress of the rail in contact are governed by the coupled elasto-plastic and heat conductive equations. The wear depth function appears as an internal variable in the non-penetration condition updating the gap between the worn surfaces of the bodies. Moreover the dissipated energy due to friction is calculated to evaluate the loss of material and to determine the shape of the contacting surfaces during the wear evolution process.
This contact problem is solved numerically using the finite element method as well as the operator splitting approach. In this approach first for a given temperature the displacements, stresses and wear depth are calculated using the semi-smooth Newton method. The plastic flow and friction inequality conditions are reformulated as equality conditions using the nonlinear complementarity functions. In the next step, for a given displacement and stress the temperature is updated using Cholesky method. The distribution of surface temperatures and stresses as well as the evolution of the shape of the contact surfaces and the wear depth are reported and discussed.

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