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MULTISCALE FEM FOR RUBBER FRICTION ON ROUGH SURFACES

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Understanding the frictional behaviour of elastomers on rough surfaces is of high practical importance in many industrial applications. For example the traction of a tire is directly linked to the material properties of the considered elastomer and the surface conditions of the road track, see [1]. One goal of our studies is to gain a deeper understanding of the underlying contact physics at all length scales. Another aim is to determine a macroscopic coefficient of friction for varying material and surface properties and to validate the results with experimental data.

For predicting the coefficient of friction certain physical effects like hysteresis, adhesion or flash temperature effects have to be taken into account. In addition the micro roughness of the surface contributes mainly to the frictional behaviour of elastomers, see [2] or [3]. To capture all details and information down to microscale at acceptable computational costs it becomes necessary to incorporate all multiphysical aspects into a multiscale framework. Some multiscale approaches for sliding rubber samples are presented in [2] and [4]. In this study a new multiscale approach for rubber friction on rough road surfaces is suggested.

One of the main aspects of rubber friction on rough surfaces is the internal energy dissipation due to cyclic loading and unloading, called hysteresis. We concentrate therefore on this physical aspect in a multiscale framework. For modelling rubber hysteresis a finite linear viscoelastic material model containing a series of maxwell elements is used. With a spectral analysis of the considered road surface a decomposition into a micro- and macro-roughness is applied. The pressure- and velocity-dependent friction law gained from homogenized micro calculations, neglecting the temperature at the moment, is then incorporated at the macro scale in the FEM formulation, see figure 1.

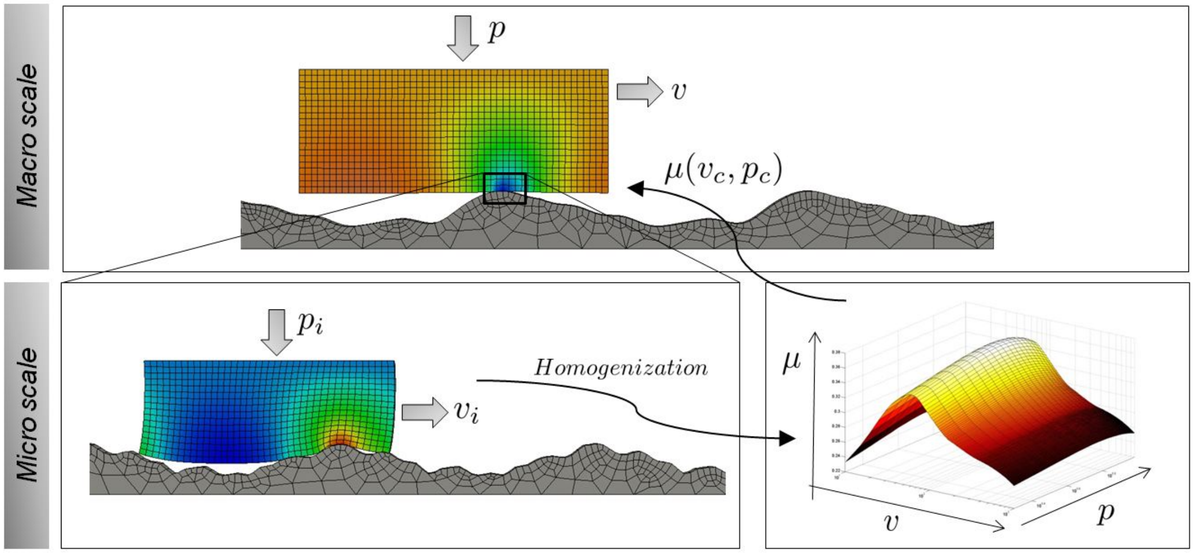

Figure 1: Multiscale framework

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