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Numerical Multi-Scale Modeling of Rubber Friction on Rough Pavements Using Finite Element Method

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Abstract : Knowledge of tire-pavement interaction plays a crucial role in designing safer and more reliable tires. Characterizing the tire-pavement frictional interaction leads to a better understanding of vehicle performance in braking and acceleration. In this work, we devise a multi-scale simulation approach to incorporate the effect of pavement surface asperities in different length-scales. We construct two- and three-dimensional Finite Element (FE) models to simulate the interaction between a rubber block and a rough pavement surface with asperities in different scales. To achieve this, the road profile is scanned via a laser profilometer and the obtained asperities are implemented in an FE software (ABAQUS) in micro and macro length-scales. The hysteresis friction, which is due to the dissipative nature of rubber, is the main component of the friction force and therefore is the subject of study in this work. Using different scales not only will assist in characterizing the pavement asperities with sufficient details but also, it is highly effective in preventing extreme local deformations and stress gradients which results in divergence in FE simulations. The simulation results will be validated with experimental results as well as the results reported in the literature.

Keywords : friction, finite element, multi-scale modeling, rubber
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