7th World Tribology Congress, WTC 2022
July 10-15, 2022, Lyon, France

Multiscale contact model for skid resistance understanding of road surface

Wiyao EDJEOU[1)*], Veronique Cerezo[1)], Hassan Zahouani[2)], Minh-Tan Do[1)]

[1)] AME-EASE, University Gustave Eiffel, Bouguenais, France
[2)] Laboratory of Tribology and Dynamics of Systems, Lyon, France.
*Corresponding author: wiyao.edjeou@univ-eiffel.fr

Skid resistance plays a major role in road safety. This property is linked to road surface texture. Thus, the evolution of road texture during its lifetime due to wear induced by road traffic and climate changes affects skid resistance performances. This phenomenon is called polishing. This paper presents a multiscale contact model based on half-space theory and wavelet decomposition applied on road texture at each scale, at each polishing state to select the most important texture scales regarding skid resistance. Resulting pressure and displacement fields are included in the friction model.

Keywords: surface texture, multiscale analysis, wavelet, skid resistance, polishing

1. Introduction

It is known from literature that skid resistance are closely related to surface texture[1]. Different scales of texture intervene in the generation of skid resistance between a tire and the road pavement. However, the influence of each scale on the skid resistance is little or not known. Moreover, during lifetime, texture of road evolves under the wear induced by road traffic (polishing) and climate changes. This texture change affects pavement surface friction [2, 3].
This research work includes a laboratory study performed on various road surfaces exhibiting a wide range of skid resistance values. The aim of this paper is to identify through a 3D multiscale contact model the relevant scales that affect surface skid resistance evolution, to better understand their contribution to friction forces generation.

2. Methods

2.1. Experimental method

Polishing tests are done with Wehner & Schulze machine to assess friction evolution under traffic[3] and 3D-cartographies of the surface are realized with optical sensor at different stages of polishing to assess surface texture evolution. Experimentations are made on circular discs of 225 mm in diameter. These discs are core samples of asphalt mix and mosaic of aggregates.

2.2. Multiscale decomposition

For multiscale decomposition, continuous wavelet decomposition is selected due to its more fine scale discretization and its fine resolution in space and frequency domain [4, 5]. Previous study done by [6] demonstrated the ability of this method to describe multiscale aspects of road surfaces.

2.3. Contact model

To handle multi-asperities influence on contact, a 3D model contact is preferred to 2D contact model[1]. Due to multiple contacting points of road surface texture, a contact model based on half-space theory is used[7]. This model takes into account the road surface texture, adhesion, contacting tire properties and slip velocity. Outputs of this model are displacement field and pressure field in tire/road contact area. These outputs are used to calculate skid resistance. Experimental skid resistance data will be used to validate the model.

2.4. Results

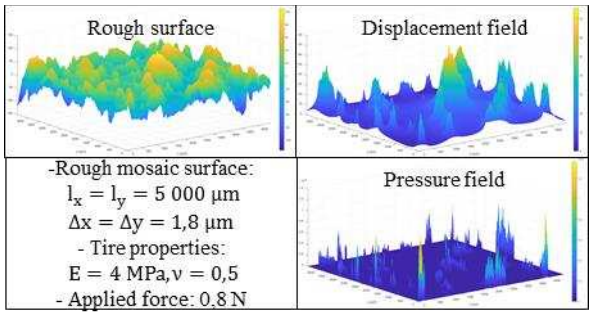

Figure 1: Example of pressure and displacement fields

3. References

1. Kane, M. et al: Skid resistance: understanding the role of road texture scales using a signal decomposition technique and a friction model. International Journal of Pavement Engineering. 0, 1–15 (2020).
2. Do, M.-T. et al: Road surface texture and skid resistance. Surface Topography: Metrology and Properties. 3, 043001 (2015).
3. Do, M.-T. et al: Pavement polishing—Development of a dedicated laboratory test and its correlation with road results. Wear. 263, 36–42 (2007).
4. Zahouani, H. et al: Multi-scale and multi-fractal analysis of abrasive wear signature of honing process. Wear. 376–377, 178–187 (2017)
5. Lee, S.-H. et al: Morphological characterisation of engineered surfaces by wavelet transform. International Journal of Machine Tools and Manufacture. 38, 581–589 (1998).
6. Edjeou, W. et al: Multiscale analyses of pavement texture during polishing. Surface Topography: Metrology and Properties. 8, 024008 (2020).
7. Polonsky, I.A. et al: A numerical method for solving rough contact problems based on the multi-level multi-summation and conjugate gradient techniques. Wear. 231, 206–219 (1999).