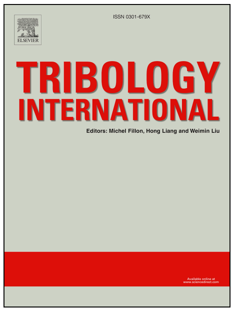
Accepted Manuscript



An improved simplified model of rough surface profile

Yuqin Wen, Jinyuan Tang, Wei Zhou, Caichao Zhu

PII: S0301-679X(18)30212-3

DOI: 10.1016/j.triboint.2018.04.025

Reference: JTRI 5204

To appear in: *Tribology International*

Received Date: 11 December 2017

Revised Date: 30 March 2018

Accepted Date: 22 April 2018

Please cite this article as: Wen Y, Tang J, Zhou W, Zhu C, An improved simplified model of rough surface profile, *Tribology International* (2018), doi: 10.1016/j.triboint.2018.04.025.

An improved simplified model of rough surface profile

Wen Yuqin[1] Tang Jinyuan[1] Zhou Wei[2] Zhu Caichao[3]

1State Key Laboratory of High Performance Complex Manufacturing,Central South University,Changsha, Hunan, China

2Intelligent Manufacturing Institute of HUNST, Hunan University of Science and Technology, Xiangtan, Hunan,China

3State Key Laboratory of Mechanical Transmission, Chongqing University, Chongqing ,China

Abstract: In order to obtain accurate characteristic parameters of contact between rough surfaces, such as curvature radius of asperity, a new method of asperity definition based on the reference line and the height of peak and valley is proposed in this paper. The real profile of the rough surface is described by parabolas. To improve the stability of contact calculation of the rough surface, the nominal contact line is taken as a simplified reference line. The simplified results show that: 1) the mean square error between the parabolas simulated by the proposed method and the real profile is smaller; 2) the calculation of contact pressure, contact area and other contact performance parameters have better stability.

Keywords: roughness; asperity; contact model; contact analysis

1. Introduction

The surfaces of mechanical parts are uneven at the micro level, characterized by a series of discretely distributed contact areas, and the real contact area which is only part of the smooth nominal contact area is far smaller than the nominal contact area. The real contact area and the contact pressure of the contact surface directly affect the bearing capacity, friction, wear, fatigue and other properties of the transmission parts [1-4].

The modeling of contact between two rough surfaces consists of two parts: the first part is the geometric modeling of rough surface morphology, and the second part is the mechanical model describing the deformation of asperities. A combination of these two parts can adequately describe the contact between rough surfaces[5-6]. Many researchers have studied the surface contact problem. Based on Hertz contact theory and the mathematical statistics method, Greenwood and Williamson[7] were the first to assume that the rough surface consists of a series of discrete asperities, where the top of the asperities is spherical and has the same radius of curvature, and the heights of the asperities follow the Gaussian distribution (GW model). The GW model has been improved significantly since its establishment [8-9]. Considering that the radius of curvature is not independent of the height distribution of asperities, Whitehouse and Archard[10] introduced the correlation between curvature radius and height of the asperity, thus modifying the GW model. In view of the shortcoming of the GW model that only the elastic deformation is considered, Chang et al.[11] established the elastic and plastic contact model of rough surfaces (CEB model) based on the principle of volume invariance. However, in this model, only two states of the asperities, i.e. the fully elastic deformation and the fully plastic deformation, are considered, and the transition state between the two is not given. To remedy the defects of the CEB model in this respect, Zhao et al. [12] used the method of interpolation to establish a surface contact model (ZMC model) which considers all the three states: the fully elastic deformation, elastic-plastic deformation and fully plastic deformation. With constant revisions and improvements, the contact model of rough surfaces based on statistics has been widely used in rough surface contact analysis. The height distribution, curvature radius and density of the asperity become the main modeling parameters.

It is worth noting that among the main modeling parameters, the asperity radius and density have the greatest influence on the contact analysis results. However, like many micro topography parameters, their values vary easily with the change of the sampling interval. As is widely known, the rough surface can be defined in a multi-scale range. The wavelength composition of the surface micro topography covers from a millimeter scale to a micron level. Accordingly, in the study of the rough contact problem, it is necessary to