A theoretical simulation of thermal EHL in impact motion

Jing Wang[1*], Na Wang[1], Peiran Yang[1], A.A. Lubrecht[2] and M. Kaneta[3]
[1] School of Mechanical Engineering, Qingdao Technological University, Qingdao 266033, P. R. China
[2] Université de Lyon, INSA de Lyon, UMR CNRS 5259, Villeurbanne, F69621, France
[3] Faculty of Mechanical Engineering, Brno University of Technology, Brno, Czech Republic
[*]Corresponding author for tribo-lyon2013@sciencesconf.org

1. Introduction

When only normal squeeze motion exists in between two lubricated surfaces, the lubrication phenomenon is named pure squeeze lubrication, which is an extreme state of transient lubrication[1]. There are numerous machine elements suffering from dynamic load, such as the contact in between rolling bearing and its raceway, or gear teeth. The quick variation of load results in violent fluctuations in film thickness, pressure and temperature.

In this study, a thermal EHL model is established to solve the impact EHL problem, in which cosine waviness exists on the steel ball surface.

2. Mathematical Model

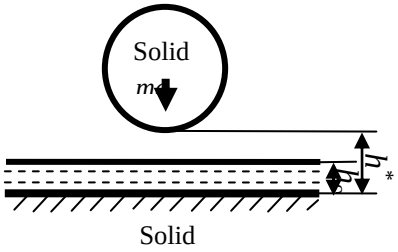


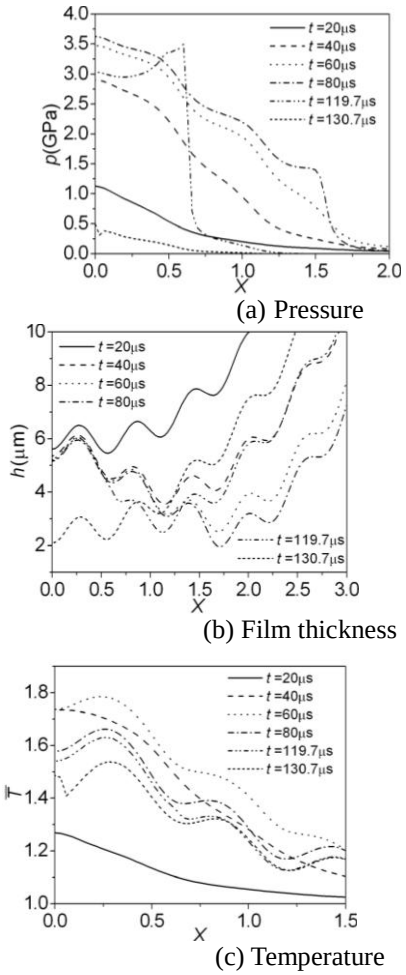
Fig. 1 A model of the impact motion

Figure 1 shows the model used in this study. A steel ball falls onto an infinite steel plane lubricated with an oil layer with thickness hoil. The surface of the steel ball, is covered with a cosine waviness. The initial gap between the oil layer surface and the lowest point of the ball is h0*. When the steel ball falls onto the plane, it forms a circular contact.

The mathematical model includes the Reynolds equation, film thickness equation, roughness function, energy equations for oil film and both solids, and some boundary conditions.

3. Results

Figure 2 shows the pressure, film thickness and temperature at the middle layer of oil film in *X*-direction during the whole impact-rebound process for h_0^* =5.0 mm, h_{oil} = 10 μm. The figures show that the surface waviness causes dramatic fluctuations in pressure, film thickness and temperature.



(a) Pressure

(b) Film thickness

(c) Temperature

Fig. 2 Pressure, film thickness and mid-layer temperature profiles in the *X* direction in the impact-bounce process (h_0^* = 5.0 mm)

4. Summary

In this paper, a thermal EHL mathematical model is built describing the impact-rebound process of a ball onto a plane. It is assumed that a cosine waviness covers the steel ball surface and the plane surface is lubricated with a layer of lubricant.

5. References

[1] Kaneta M., Guo F. and Wang J., Impact micro-elastohydrodynamics in point contacts, ASME Journal of Tribology, 2011, 133: (031503)1-9.