

## A FAST CALCULATION APPROACH FOR FINITE-LINE THERMAL EHL CONTACTS: MOTIVATING BEARING SIMULATION TECHNIQUES

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### KEYWORDS

*EHL; Friction; Modelling in tribology; Rolling element bearing*

### ABSTRACT

Rolling element bearings commonly operate within the regime of thermal Elastohydrodynamic Lubrication (TEHL). TEHL models are essential for simulating the tribo-dynamic and thermal characteristics of bearings. These models necessitate the simultaneous resolution of the Reynolds equation, elastic deformation equation, and energy equation, a process that is typically too computationally intensive for direct integration into bearing models. An alternative scheme in the literature is invoking the TEHL algorithm after completing the bearing tribo-dynamics analysis to assess the bearing TEHL behavior, which however ignores the important feedback of thermal effect on the bearing tribo-dynamic behaviors [1]. Therefore, to achieve a comprehensive coupling of TEHL and tribo-dynamic behaviors of bearings, there is a pressing need for a TEHL model that boasts rapid computational efficiency and the capability to accurately predict film thickness, friction force, film heating rate, micro temperature fields, and power density on contact surfaces.

In this study, a fast calculation approach for finite-line TEHL contacts is proposed. The basic idea is to reduce the dimensions of governing equations ignoring the secondary terms and reconfigure the coupling mechanism among lubricant film, elastic deformation and temperature field. The proposed approach can correctly predict the contact pressure and film thickness for actually profiled contacts irrespective of the presence of tilting contact. Furthermore, as depicted in Fig.1(a) and (b) the approach effectively predicts the temperature distribution within the lubricant film and the heat flux on the contact surfaces. The friction coefficient, as demonstrated in Fig. 1(c), is accurately predicted across a wide range of operating conditions, revealing distinct zones such as the Newtonian, non-Newtonian, limiting shear stress, and thermal regions. Crucially, the method requires less than 1 second per load case, facilitating its direct integration into bearing models and advancing bearing simulation technology.

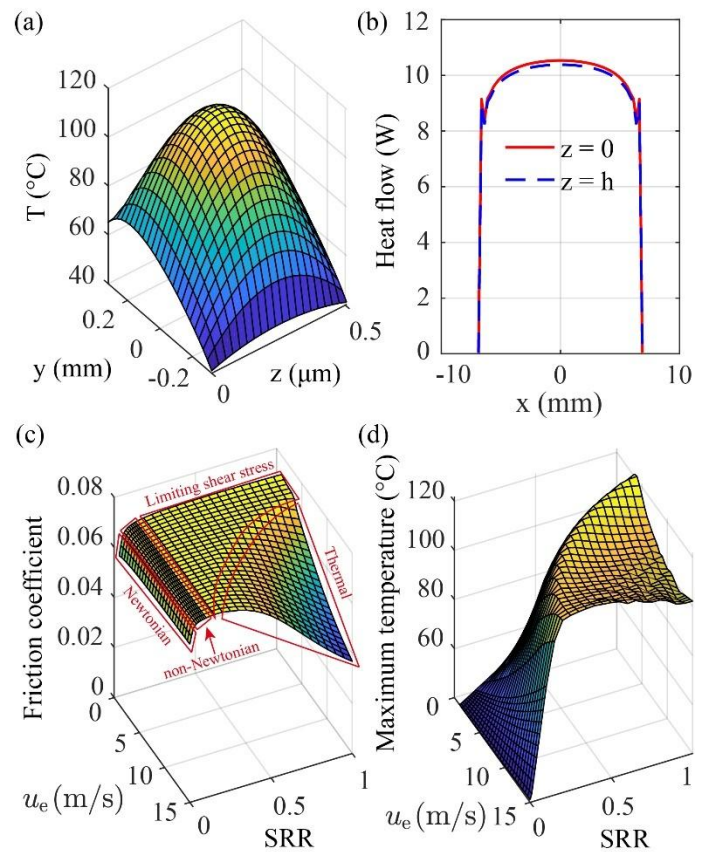


Fig.1 (a): Lubricant film temperature field at central position; (b): Heat flow distribution along the contact line; (c): Friction coefficient; (d): Maximum temperature in the film.

### REFERENCES

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