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# Finite Line Contacts EHL Analysis of Misaligned Logarithmically Profiled Roller

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## 1. Introduction

The EHL of finite line contacts occur in machine elements such as roller bearings, disk cam and roller followers. The rollers are profiled their ends to relieve high edge stress concentration caused by their finite length and misalignment. Until now, the profile design is mainly depend on the elastostatic analysis and it is generally understood that the logarithmic profile (Lundberg profile) to be the best for uniform pressure distribution. However, the rollers and races are separated by the EHL film and the pressure distribution is different from those of elastostatic state.

Although the Lundberg profile is commonly used in roller bearing design, few EHL studies concerning this profile have been reported. Sun and Chen [1] introduced the profile modification coefficient and obtained converged solutions, however, some of their results were physically inconsistent. Therefore, more studies are required to investigate detailed EHL behaviors.

In this study, a numerical analysis is carried out to study the effect of profile modification coefficient and roller misalignment on the EHL of a Lundberg-profiled cylindrical roller. The EHL results are compared and variations of the minimum film thicknesses with dimensionless parameters, profile modification coefficient and misalignment are presented.

## 2. EHL film thickness

In EHL film thickness, the profile modification coefficient, $\delta$, is defined as

$$h_g = \frac{x^2}{2R} + \delta \times \begin{cases} -\dfrac{2w}{\pi E l} \ln\left\{1-\left(\dfrac{2y}{l}\right)^2\right\}, & |y| < \dfrac{l}{2} \\ \dfrac{2w}{\pi E l}\left\{1.1932 + \ln\left(\dfrac{l}{2c}\right)\right\}, & |y| = \dfrac{l}{2} \end{cases}$$

## 3. Numerical methods

To solve the highly nonlinear EHL problems, a finite difference method with non-uniform grids and the Newton-Raphson method is used [2,3]. Irregular grids of 101x61 are constructed over the computation zone, and the numerical data used are as follows: $R$ = 5 mm, $l$ = 10 mm, $E$ = 220 GPa, $Z$ = 0.55, $\eta_o$ = 0.0411 Pa·s.

## 4. Results and discussions

Near roller edge region, the pressure distributions and film thicknesses for different profile modification coefficient are shown in Fig. 1 ~ Fig. 3. In Lundberg profile, the minimum film thickness occurred always near the edge region [3]. The minimum film thickness can be increased with proper adoption of the profile modification coefficient. And very small misalignment can influence highly on the EHL results.

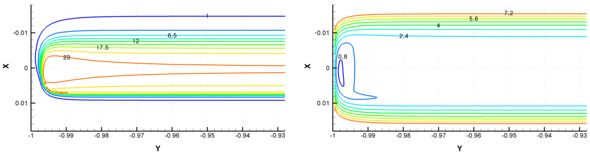

Fig. 1 Pressure and film contour for Lundberg profile.

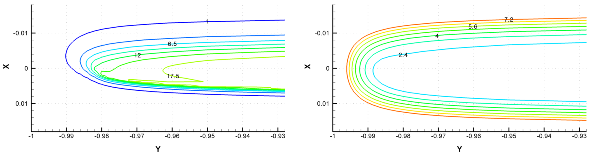

Fig. 2 Pressure and film contour for $\delta$ = 2.5.

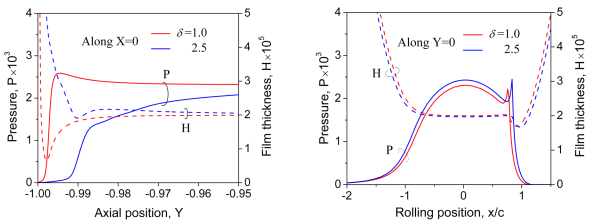


Fig. 3 Comparison of pressure and film thickness.

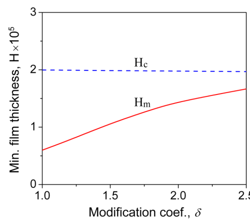


Fig. 4 Variations of the minimum and central film thicknesses with profile modification coefficient.

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## 5. References

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