Bridging Theory and Practice in Transient Elastohydrodynamic Lubrication: Implementation and Experimental Insights

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Abstract

This study offers a fresh perspective on the elastohydrodynamic lubrication (EHL) regime under time-varying conditions, with a focus on applications in fretting-like scenarios. By developing a comprehensive analytical solution to the Reynolds equation for forced oscillations, the work captures the dynamic evolution of film behavior with unprecedented accuracy. Experimental validations confirm the predictive power of the derived equations, which effectively model key phenomena: the transient squeeze effects shaping film thickness over time, asymmetry and hysteresis in film distribution due to directional changes, and transport effects. Furthermore, integrating these analytical equations with a modulation of the inlet flow accurately predicts starvation effects caused by directional reversals, where the former outlet zone transitions to the next inlet zone. The implementation of the analytical solution was facilitated using **IssyOsborne**, our open-source and open-access software, enabling precise modeling and reproducibility of results. The study also examines the critical influence of lubricant viscosity and contact velocity on film behavior, providing a deeper understanding of their roles in EHL dynamics. Finally, compelling results under fretting-like conditions further enhance the relevance of this work, offering valuable insights into oscillatory contact scenarios. This comprehensive approach highlights the robustness and accessibility of the analytical and experimental findings.

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