Transition from boundary to hydrodynamic lubrication

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Abstract

The addition of a thin lubricant film in between two sliding surfaces is a widely employed strategy to reduce friction. However, at large normal force, the lubricant film is squeezed out and the sliding friction is governed by contact mechanics (boundary lubrication). The transition to the hydrodynamic lubrication is reached when a critical sliding speed is applied to overcome squeezing force. The transition between those frictional states for rough surfaces is still not fully understood, and will be the focus of this work.

We use a mean-field EHD lubrication model, inspired by the work of Persson and Scaraggi (J. Phys.: Condens. Matter 21 (2009) 185002), where the pressure is split into a contact and an hydrodynamic part and we perform both numerical and analytical analysis. Lubricated systems offer a large scale separation between microscopic scales (film thickness and roughness) and the macroscopic scale of contact. We exploit this scale separation and use asymptotic matching technics to characterise the different regimes of friction.

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