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Flow between a cavity and a flexible wall: Lubrication model and finite-element calculations SATISH KUMAR, XIUYAN YIN, University of Minnesota — Flows near deformable solid boundaries occur in a diverse range of settings including coating and printing processes, biological systems, and suspensions. In order to examine the effect of surface topography on the elastohydrodynamic interactions that arise in these flows, the flow between a rigid cavity and a flexible wall is studied using a lubrication model and finite-element calculations. In the lubrication model, Reynolds equation for the fluid is coupled to a model for a uniformly tensioned wall, resulting in a coupled system of nonlinear ordinary differential equations. When the wall tension is small relative to viscous forces, the wall easily deforms and assumes a shape similar to that of the cavity. The pressure profiles are also dramatically altered and in some cases show only a valley without a mountain. Cavity shape is found to have a significant influence on both the pressure profiles and the wall deformation. Predictions from the lubrication model agree remarkably well with those from finite-element solution of Stokes' equations coupled with the wall model. The finite-element calculations also suggest that replacing the bottom of a cavity with a flexible wall and applying a time-periodic pressure to it may be a potentially useful way to improve mixing and heat/mass transport in the cavity.

Satish Kumar
University of Minnesota

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