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Bottom reconstruction in power-law thin-film flow over topography[1] SYMPHONY CHAKRABORTY, USHA RANGANATHAN, Department of Mathematics, IIT Madras, Chennai 600036, Tamilnadu, India — We consider a thin film of a power-law fluid flowing over an undulated substrate under the action of gravity. Instead of determining the free surface position as in the case of the direct problem, we focus on the inverse problem where for a specific free surface shape, we find the corresponding bottom topography which causes the free surface profile. As an asymptotic approach for thin films and moderate Reynolds numbers, we apply the WRIBL method which enables us to derive a set of two evolution equations for the film thickness h and the flow rate q. We obtain the steady solutions of the above model equation for the inverse problem for weakly undulated free surface profile by a perturbation method. For a strongly undulated free surface shape, we solve the model equation numerically and obtain the bottom topography. We examine the influence of of viscosity of fluid, inertia, film thickness, hydrostatic pressure and surface tension on the reconstructed bottom topography for shear-thinning as well as shear-thickening fluids. The results reveal that compared to shear-thickening fluid, wavy free surfaces for shear-thinning fluid require strongly undulated topographies with steep troughs. Parametric studies show that this effect increases with increasing free surface amplitude.

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