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Thin Film Flows Near Isolated Humps and Interior Corners

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We examine the surface-tension-driven redistribution of a Newtonian liquid film following a sudden change in the shape of its substrate, which is assumed to form an isolated hump or interior corner. The flow is modelled with an evolution equation derived from lubrication theory, extended for corner flows via fully nonlinear expressions for interfacial curvature and volume conservation. We employ numerical simulations and asymptotic analysis to describe the film dynamics. For sufficiently large humps and sharp corners, the film pinches off to form an effective contact line separating a quasi-static puddle from a wave-like disturbance that propagates into the far field. We show that this effective contact line drifts slowly to a limiting position dictated by the transient dynamics. Flows off humps with maxima less than a critical height do not exhibit pinch-off and are captured by one of two possible branches of similarity solutions of the thin-film equation.

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