Cheng, Po-Jen; **Lai, Hsin-Yi**
Finite-amplitude long-wave instability of Bingham liquid films. (English) [Zbl 1162.35439]
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Summary: The long-wave perturbation method is employed to investigate the weakly nonlinear hydrodynamic stability of a thin Bingham liquid film flowing down a vertical wall. The normal mode approach is first used to compute the linear stability solution for the film flow. The method of multiple scales is then used to obtain the weak nonlinear dynamics of the film flow for stability analysis. It is shown that the necessary condition for the existence of such a solution is governed by the Ginzburg-Landau equation. The modeling results indicate that both the subcritical instability and supercritical stability conditions can possibly occur in a Bingham liquid film flow system. For the film flow in stable states, the larger the value of the yield stress, the higher the stability of the liquid film. However, the flow becomes somewhat unstable in unstable states as the value of the yield stress increases.

MSC:

35Q35   PDEs in connection with fluid mechanics

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stability analysis; Bingham liquid film; Ginzburg-Landau equation

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