Stability analysis of condensing liquid film flowing down an inclined plane

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In order to observe the behavior of liquid flows in an inclined plane, several studies have been shown to analyze the stabilities of thin liquid film under condensation. In the present study, we concentrate on stabilities of condensing thin liquid film flows. A liquid layer flowing down an inclined plane uniformly cooled wall is considered in the study. The thin layer is considered as Newtonian incompressible fluid with constant physical properties except the surface tension. We derive evolution equations by using long-wave approximation for two dimensional disturbances. These equations incorporate the dynamics at the interface involving the effect of mass gain due to condensation, surface tension, gravity, wave propagation and thermocapillary. The linear stability analysis is performed in a basic state having a flat interface and nonlinear stability analysis also performed by using numerical computation based on Fourier-Spectral method. The thermocapillarity and mass gains act as stability effects while the gravity makes the filmwise condensation more unstable as the inclination angle with the horizontal increases.