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Air-driven viscous film flow coating the interior of a vertical tube[1]
H. REED OGROSKY, Virginia Commonwealth University, ROBERTO CAMASSA, JEFFREY OLANDER, University of North Carolina — We discuss a model for the flow of a viscous liquid film coating the interior of a vertical tube when the film is driven upwards against gravity by airflow through the center of the tube. The model consists of two components: (i) a nonlinear model, exploiting the slowly-varying liquid-air interface, for the interfacial stresses created by the airflow, and (ii) a long-wave asymptotic model for the air-liquid interface. The stability of small interfacial disturbances is studied analytically, and it is shown that the modeled free surface stresses contribute to both an increased upwards disturbance velocity and a more rapid instability growth than those of a previously developed model. Numerical solutions to the long-wave model exhibit saturated waves whose profiles and velocities show improvement, with respect to the previous model, in matching experiments. The model results are then compared with additional experiments for a slightly modified version of the problem.

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