Abstract Submitted
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Phase diagram for the onset of rolling waves and flow reversal in inclined falling films WILKO ROHLFS[1], RWTH - Aachen, BENOIT SCHEID[2], University Libre de Bruxelles, REINHOLD KNEER[3], RWTH - Aachen — The onset of rolling waves and the onset of flow reversal in inclined falling films is investigated in dependence of the Reynolds and the inclination number. For this, the weighted integral boundary layer model (WIBL) and direct numerical simulations (DNS) are used. Analytical criteria for the onset of rolling waves and flow reversal based on the wave celerity, the average film thickness and the maxi-mum/minimum film thickness have been approximated using self-similar parabolic velocity profiles. This approximation has been validated by second-order WIBL and DNS simulations. It is shown that the various transitions in the phase diagram for homoclinic solutions (waves of infinite wave length) are strongly dependent on the inclination, but independent on the streamwise viscous dissipation effect. Compared to the onset of flow reversal, the onset of rolling waves occurs for higher Reynolds numbers, resulting in a regime in which flow reversal and non-rolling waves coexist. Furthermore, simulation results for limit cycles (finite wave length) reveal a strong increase of the critical Reynolds number with the excitation frequency.

[1]Institute of Heat and Mass Transfer, Augustinerbach 6, 52056 Aachen, Germany
[2]C.P. 165/67, Avenue F.D. Roosevelt 50, 1050 Bruxelles, Belgium
[3]Institute of Heat and Mass Transfer, Augustinerbach 6, 52056 Aachen, Germany

Wilko Rohlfs
RWTH - Aachen

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