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Bifurcation analysis of liquid films flowing under an inclined plane

DMITRI TSELUIKO, Loughborough University, MARK BLYTH, University of East Anglia, TE-SHENG LIN, National Chiao Tung University, SERAFIM KALLIADASIS, Imperial College London — Consider a liquid film flowing under an inclined plane. This flow is analyzed using both a long-wave model and the Stokes equations for zero Reynolds number. The solution space is investigated by constructing bifurcation diagrams using a novel continuation method allowing for the computation of travelling waves, including solitary pulses and their bound states, as well as spatially varying time-periodic solutions. As the inclination angle decreases the amplitude and speed of pulses grow and become infinite at a critical value of the angle. Asymptotics for this limit are developed. The effect of an electric field is also considered, and it is found that it can be used to alter the dynamics from a chaotic regime to a regularized one described by interacting large-amplitude pulses with recirculation zones in the humps. A coherent-structure theory for such pulses is developed and good agreement is found with numerical simulations.

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[2] M.G. Blyth, D. Tseluiko, T.-S. Lin, S. Kalliadasis, Coherent-structure theory and the formation of bound states on electrified falling films. Submitted

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