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Oscillatory states in two-pulse dynamics in falling liquid films[1]
MARC PRADAS, School of Mathematics and Statistics, The Open University, DMITRI TSELUIKO, Department of Mathematical Sciences, Loughborough University, SERAFIM KALLIADASIS, Department of Chemical Engineering, Imperial College London — A liquid film flowing down an inclined plane is an example of a convectively unstable open-flow hydrodynamic system with a rich variety of spatiotemporal structures. At the latest stage of the evolution, the film surface is dominated by interacting solitary pulses, which under certain conditions may form bound states. In our previous coherent-structure theories [1-3], we showed that bound states play a crucial role in the dynamics of film flows and can be described in terms of weak interactions. In this study, we analyse strong interactions between pulses and in particular the dynamic states emerging when pulses are sufficiently close to each other, namely oscillatory states. We show that the oscillatory dynamics is associated with a peculiar object, the so-called resonance pole, which may give rise to either self-sustained or damped oscillations, something that largely depends on the particular values of the system parameters and the initial pulse separation length. We find excellent agreement between analytical and numerical work. [1] M. Pradas, D. Tseluiko, S. Kalliadasis. Phys. Fluids 23, 044104 (2011). [2] M. Pradas, S. Kalliadasis, P.-K. Nguyen, V. Bontozoglou. J. Fluid Mech. 716 R2 (2013). [3] D. Tseluiko, S. Kalliadasis. IMA J. Appl. Math. 79, 274 (2014).

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