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Hydrodynamic Characterization of Harmonically Excited Falling-Films: A Detailed Experimental and Computational Study ALEXANDROS CHAROGIANNIS, Department of Chemical Engineering, Imperial College London, FABIAN DENNER, BEREND VAN WACHEM, Department of Mechanical Engineering, Imperial College London, MARC PRADAS, Department of Mathematics and Statistics, The Open University, SERAFIM KALLIADASIS, CHRISTOS MARKIDES, Department of Chemical Engineering, Imperial College London — We investigate the hydrodynamic characteristics of harmonically excited liquid-films flowing down a 20 incline by simultaneous application of Particle Tracking Velocimetry and Planar Laser-Induced Fluorescence (PLIF) imaging, complemented by Direct Numerical Simulations. By simultaneously implementing the above two optical techniques, instantaneous and highly localised flow-rate data were also retrieved, based on which the effect of local film topology on the flow-field underneath the wavy interface is studied in detail. Our main result is that the instantaneous flow rate varies linearly with the instantaneous film-height, as confirmed by both experiments and simulations. Furthermore, both experimental and numerical flow-rate data are closely approximated by a simple analytical relationship, which is reported here for the first time, with only minor deviations. This relationship includes the wave speed c and mean flow-rate $\overline{Q}$, both of which can be obtained by simple and inexpensive measurement techniques, thus allowing for spatiotemporally resolved flow-rate predictions to be made without requiring any knowledge of the full flow-field from below the wavy interface.

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