Proceedings ECS 2021
Brussels, Belgium, September 7-9, 2021

Abstract T-70

TO DRIP OR NOT TO DRIP: PATTERN FORMATION OF A THIN FILM FLOWING UNDER AN INCLINED PLANE

***P. G. Ledda*[1], *G. Lerisson*[1], *G. Balestra*[2] *and F. Gallaire*[1]**

[1]Laboratory of Fluid Mechanics and Instabilities, EPFL, Lausanne, Switzerland
[2] iPrint Institute, HEIA-FR, HES-SO University of Applied Sciences and Arts Western Switzerland, Fribourg, Switzerland

Email: pier.ledda@epfl.ch

Abstract
We discuss the pattern formation of a thin film flowing under an inclined plane, with theoretical, experimental and numerical analyses, in the context of the Rayleigh-Taylor instability and in the absence of inertia.

Keywords*: coating, instability, rivulets, dripping*

A very viscous Newtonian fluid is injected under an inclined glass plate, with a constant flow rate (Fig. 1(a)). We study the dynamics of the flat film to spanwise perturbations at the inlet. Spanwise-periodic and streamwise-aligned structures, called rivulets, invade the domain (Fig. 1(b)).

The emergence of rivulet structures is numerically and experimentally rationalized via the weakly non-linear impulse response of a flat film. The fully non-linear evolution leads to a steady pattern characterized by rivulets. The rivulet profile is described by a two-dimensional static pendant drop with imposed flow rate.

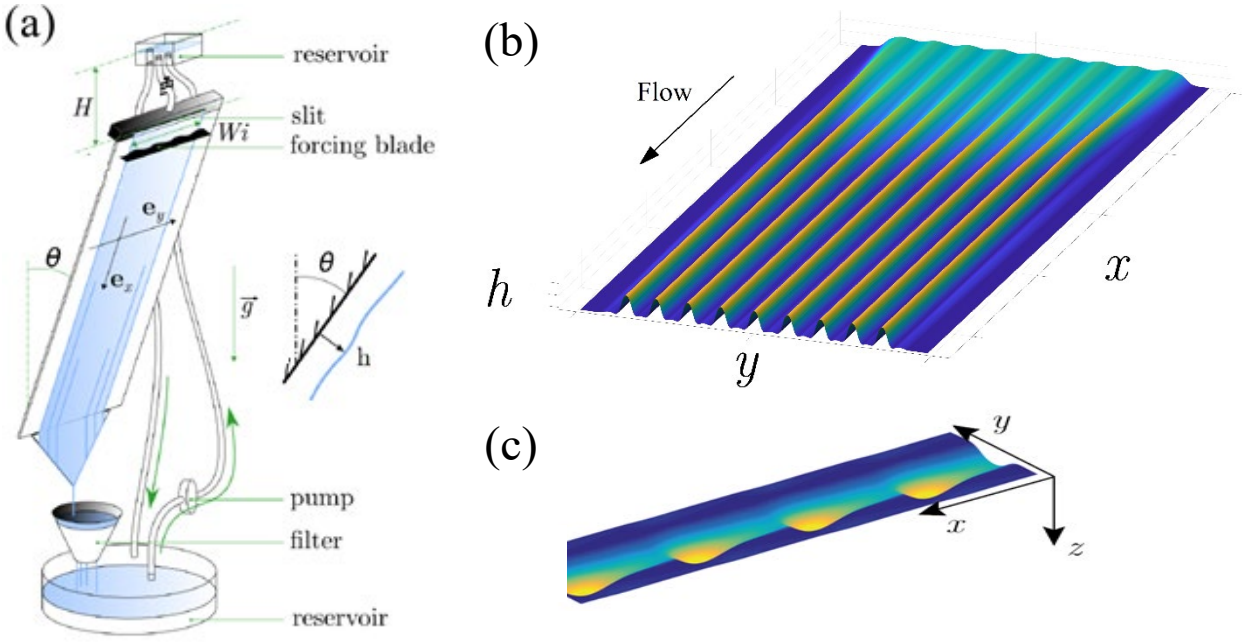

Figure 1. (a) Flow configuration and experimental set-up. (b) Experimental measurement of the film thickness in which rivulets invade the domain. (c) Sketch of a rivulet with lenses.

A secondary stability analysis on the rivulet profile reveals that as the flow rate or the inclination angle are decreased the rivulets are progressively stabilized until quenching of the instability.

As a result of the instability, lenses traveling on the rivulets are observed (Fig. 1(c)), which are numerically studied in the context of imposed temporal harmonic forcing at the inlet.

In a last step, these lenses may eventually drip from the inclined ceiling.