Chair: Physics of Fluids group

Sliding of oil-engulfed droplets

Project description

The sight of rain droplets sticking to window panes is fairly ubiquitous. Upon closer inspection, one can see that sometimes the droplets stick, whereas on other occasions they slide. While sticky droplets may be fine on a window pane, they can be quite a nuisance on the windshield of a car or on the lenses of prescription glasses. One way to get rid of this droplets is to make the surface slippery by coating it with a thin layer of a transparent oil. This facilitates gravity-driven sliding of the water droplet. In such a situation, depending on the interfacial tensions, the oil may completely engulf the water droplet (as shown in Fig. 1). However, how this engulfment affects the sliding behavior of the water droplet is not yet fully understood. In this work, we will numerically study the sliding behavior of water droplets engulfed by an oil layer.

Figure 1: Water droplet engulfed by an oil layer (adapted from [1]).

What are the learning components?

Learning expectations are two-fold; (i) familiarity with the state-of-the-art simulation code, Basilisk C. (ii) Hands-on experience with comparing the models for drop sliding velocities with the numerical experiments obtained from step (i).

Specifically, the intern will learn

1. volume of fluid (VoF) numerical simulation using Basilisk C to model sliding of droplets
2. modeling and analyzing four-phase systems with multiple three-phase contact lines.
3. handling pinning and sliding in these multi-phase systems

What will the students do?

In the Physics of Fluids group, we are looking for enthusiastic students to join our newly established project on sliding of oil-engulfed droplets.

1. They will study wetting phenomena in 4-phase systems, precursor films, and viscous dissipation.
2. They will work with experimentalists.
3. They will work with the Computational Fluid Dynamics (CFD) fundamentals, and use the free software program Basilisk C (http://basilisk.dalembert.upmc.fr).
4. They will undertake basic and advanced scientific data analysis.

For any questions, please feel free to contact Vatsal; details below:

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References

[1] Y. Li, C. Diddens, T. Segers, H. Wijshoff, M. Versluis, and D. Lohse. Evaporating droplets on oil-wetted surfaces: suppression of the coffee-stain effect. *Proc. Natl. Acad. Sci. USA*, 117(29):16756–16763, 2020.