Fluid transfer between merging droplets

Laboratory Name: Stoeber Lab
Faculty Supervisor: Prof. Boris Stoeber

General Area of Research

Experimental fluid mechanics, microscopy, data analysis

The Project

On-chip manipulated droplets have emerged as a highly effective method for creating controlled environments for reaction vessels and cell constructs. These droplets possess well-defined volumes and offer various strategies for exchanging liquids and solids across their boundaries, enabling applications such as nutrient supply to cultured cells. One particularly promising concept involves the utilization of paired droplets: sessile droplets that rest on a substrate and pendant droplets that hang underneath it [1]. By aligning a sessile droplet directly above another sessile droplet, vertical movement can be induced, causing the droplets to merge and facilitating fluid transfer between them as shown in Fig. 1. The volume of fluid transferred depends on multiple parameters, including fluid properties, droplet geometries, and contact duration.

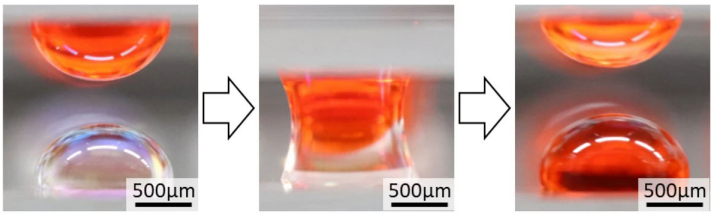

Figure 1: Red coloured fluid is transferred from a pendant to a sessile droplet; the three sequential photographs show a droplet pair before, during and after contact (from [1]).

To gain a comprehensive understanding of the transferred volumes as a function of experimental parameters, it is essential to measure the flow field inside the merging droplets. An effective approach for quantifying these flow fields is to employ imaging seed particles within the droplets, combined with particle image velocimetry. This methodology allows for accurate measurement of the flow characteristics and enables the description of transferred volumes based on experimental parameters.

Reference

[1] S. Konishi, C. Ohya, T. Yamada, "Selective control of the contact and transport between droplet pairs by electrowetting-on-dielectric for droplet-array sandwiching technology", Scientific Reports, vol. 11, art. 12355, 2021.

Tasks to be performed by the student

- Identify the important parameters of this problem
- Design and build a simple experimental setup
- Design experimental procedures
- Conduct experiments to collect image data
- Process image data and analyze the results

Facilities and team

Prof. Stoeber's team has access to advanced imaging equipment for this work. The student will work closely with a member of Prof. Boris Stoeber's group. Occasional meetings will be held with collaborators in Japan to provide project updates. Contact: boris.stoeber@ubc.ca

Supervision Received

The student will be assisted on a regular basis by a research mentor, and will receive guidance from Prof. Stoeber. The student will be trained on relevant equipment and measurement techniques.