Jian Wei Khor & Troy O'Neal EE368 Project Proposal jkhor@stanford.edu
toneal@stanford.edu

Image Processing Algorithm for Drop Breakup Characterization

Microfluidics is a research area that focuses on studying fluids in the length scales of 100 µm or less. Recently, there has been interest in using drops as vessels to study chemical reactions and single cell studies[1]. However, some channel designs could cause drops to break unintentionally.

We would like to study the physical parameters that cause drops to breakup in a constriction. Our channel of interest, a tapered channel seems to promote squeezing between drops which consequently causes drops to break at the constriction. A single layer of monodisperse drops (drops that are the same volume) will be used to flow through the microfluidic channel. Furthermore, these monodisperse drops are packed together to produce a high volume fraction (high number of drops per volume).

For the image processing algorithm, we want to characterize the drop pair (drop A and B) prior to flowing into the constriction (ie. Centroid of each drops, drop morphology, drop major and minor axis, drop orientation). We also want the algorithm to detect drops that break (break = 1 or no break =0). This algorithm will enable us to find the physical parameters that are important for breakup.

Image processing techniques learned from class will be utilized in this project. Furthermore, image processing techniques that are published in research literatures will be utilized as well. The biggest challenge here is to be able to detect edge of the drops when it is flowing through the channel. Due to the high volume fraction of the droplets together with how close the drops are to the channel wall. It is hard to detect the edges of some of the drops. It would be crucial for the algorithm to detect all the drops as we want the physical parameters of all the drops that flow through the channel. Fortunately, a published algorithm was found to be able to determine edges of clustered objects[2,3]. Deblurring images will also be attempted for this project[4]. Finally, some common imaging techniques to detect drops in a microfluidic channel will be reviewed and possible implemented as well[5].

Matlab will be used. Android devices are not required.

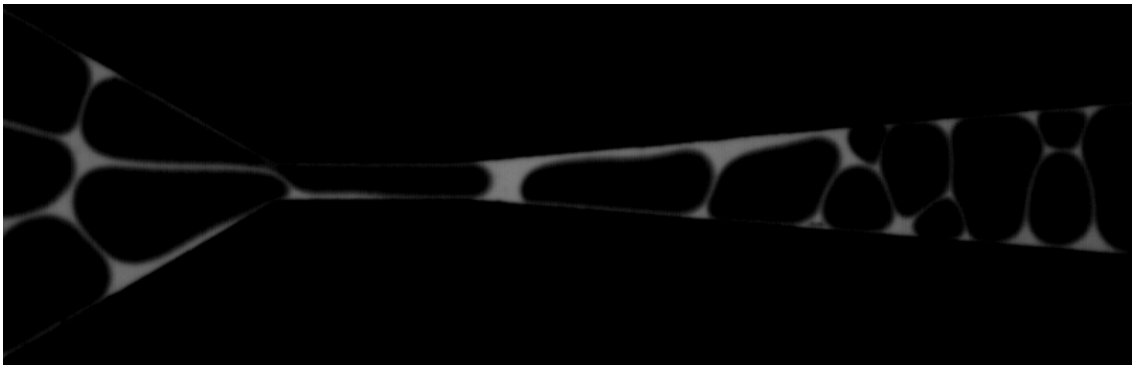

Figure 1. Sample Image from recorded video

References

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