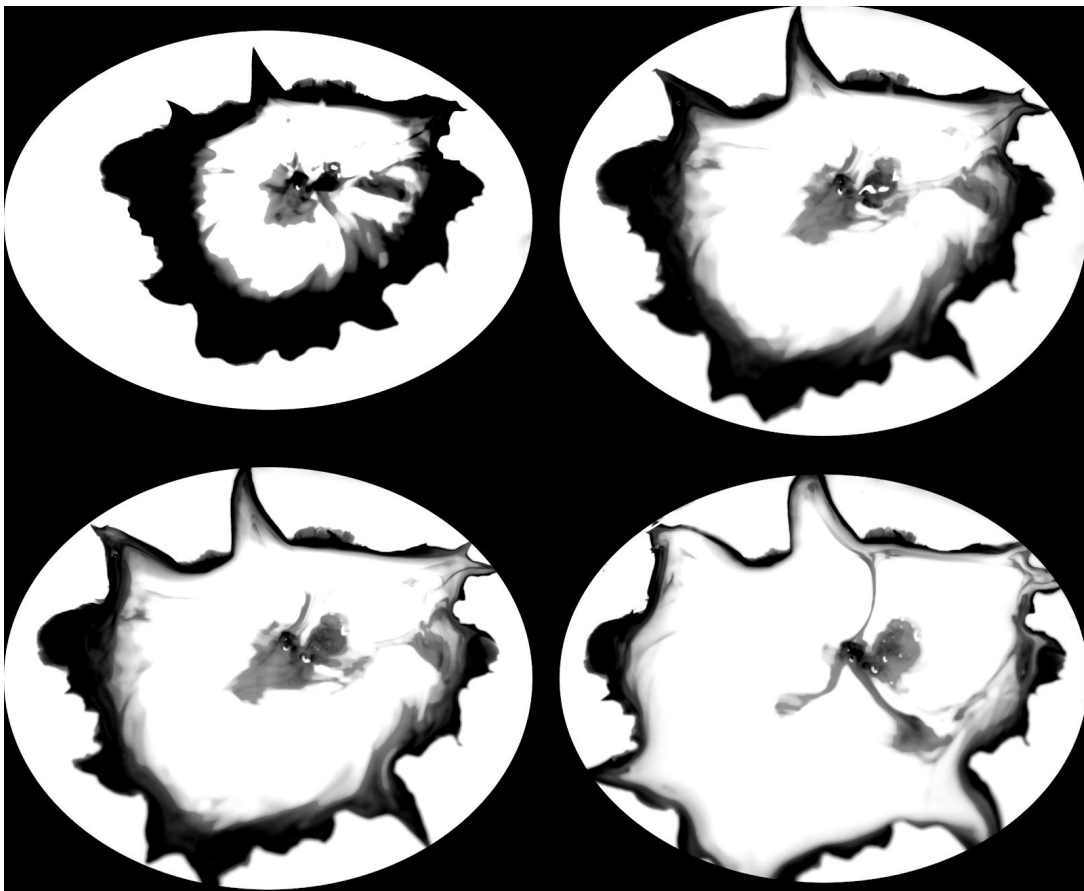


Flow Visualization

Team 3rd Image - Report
MCEN 5151

Wenjin Li
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Introduction

As a team, we did experiment with food dye in milk. Team member includes Chad Solan, Chris Mcfadden, Will Tse and myself (Wenjin Li). The final images selected from a series of continuous shot images. The combined image properly showed the phenomenon of surface tension.

Flow

The physics behind is surface tension. The surface tension (interface tension) between two types of liquid. In this case are food dye and milk.[1] Because of the difference between food dye and milk, the surface tension causes food dye can't dilute into milk. When we dropped the soap into the center of the food dyes, the surface tension pulls those food dye toward the out boundary. Therefore, we can see those food dye flow toward the outside (inside of inside).[2]

Visualization Technique

To create a stable environment, my group members and I set up the equipments on top of a table. The equipments include milk, food dye, bowl, and table. First, we turned on the lights and lower the distance between the light source with the bowl. Before we focused the camera, we pre-dropped the food dye into the milk. Then, we pre-focused on one spot with an object, then removed the object and tried to drop the dish soap toward the spot. With this method, we got well-focused photographs. The setup schematic is shown below in figure 1.

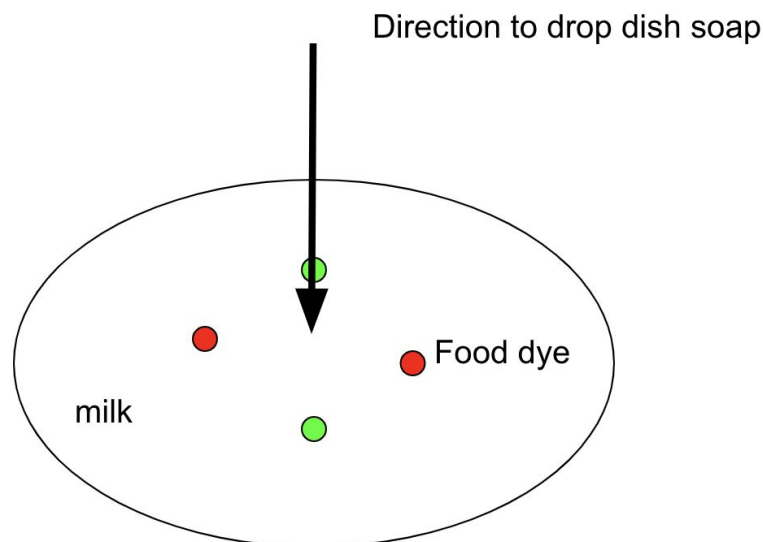


Figure 1. Setup Schematic

Photographic Technique

The size of the field of view is about 30cm * 30cm. Distance from object to the lens is about 40cm. I used a Sony A7III camera. Sony A7III is a mirrorless camera, which released in 2018. The lens model is FE 28-70mm, F3.5-5.6 OSS. Focal length is 70mm. The aperture is F5.6, with shutter speed 1/100s and IOS 2000. The exposure compensation is +2EV. The original image's resolution is 6000*4000. I used "PhotoScape X" software to do image processing on MacBook Pro.

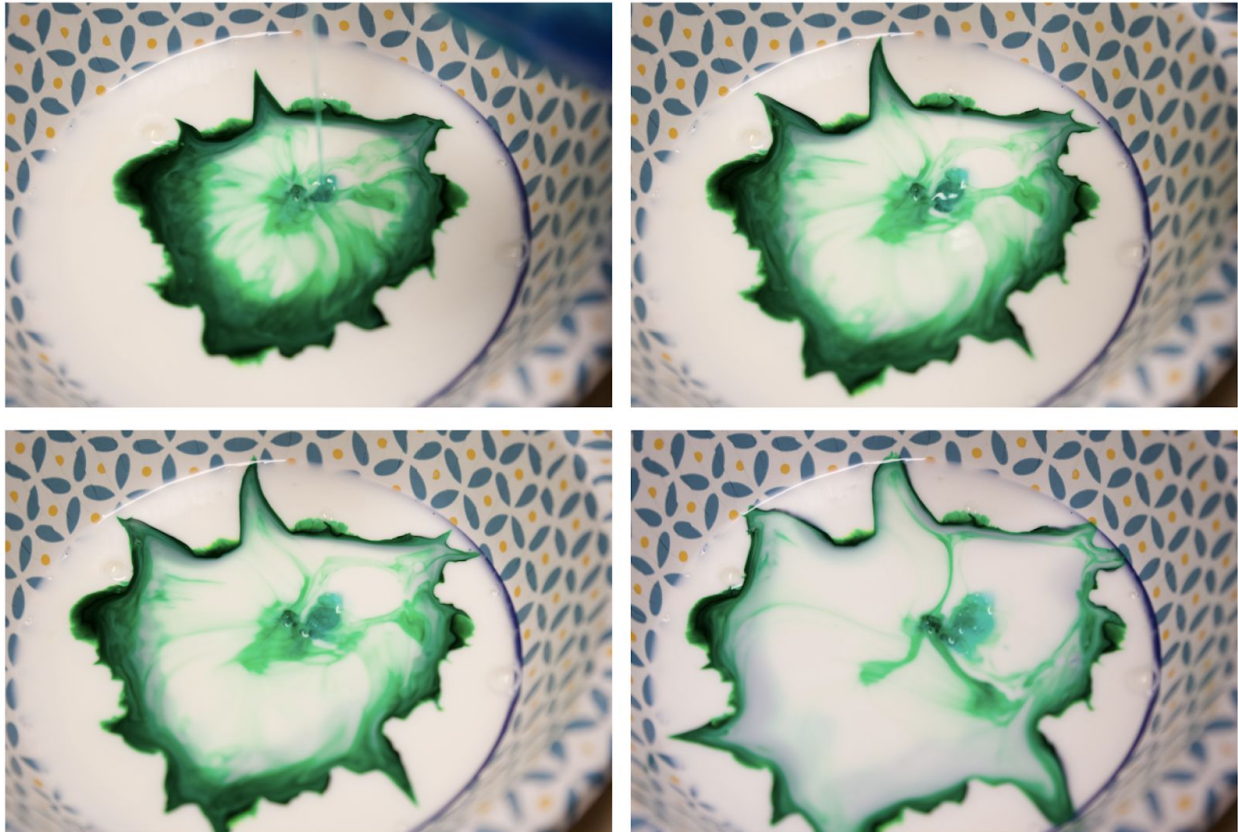


Figure 2. Original Images

Above is the original images (figure 2). The image processing includes adding a color filter(black and white), sharpen the flow, cropping the boundary, combining four images, shrinking the size down (1280*1422) and converting the format (.raw to .png). I also did another edited version - gif image. That format provides a dynamic view of the flow phenomenon.

Image Reveal

The image well captured the surface tension under milk with food dye. I am pretty happy with the color contrast after post-processing. Due to the motion blur, I added a black and white filter

to reduce the noise and blur. By having that color contrast, the noise and blur successfully reduced. In the future experiment, I would like to enhance the sharpness and reduce the noise.

Reference

[1] Surface Tension - Definition and Experiments

<https://www.thoughtco.com/surface-tension-definition-and-experiments-2699204>

[2] Surface Tension Lecture 4: Marangoni Flows. MIT, Retrieved

<http://web.mit.edu/1.63/www/Lec-notes/Surfacetension/Lecture4.pdf>