Soap Bubble Visualization

Second Team Project

John Monahan

MCEN 4151

Flow Visualization: The Physics and Art of Fluid Flow

4/9/18

Background

The purpose of the Team Second image assignment is to capture a fluid, or combination of fluids, to understand the physics of the flow in the experiment. The experiment must be controlled so it can be repeated. In this experiment, my team and I wanted to see what would happen to a bubble under a direct lighting source.

Setup

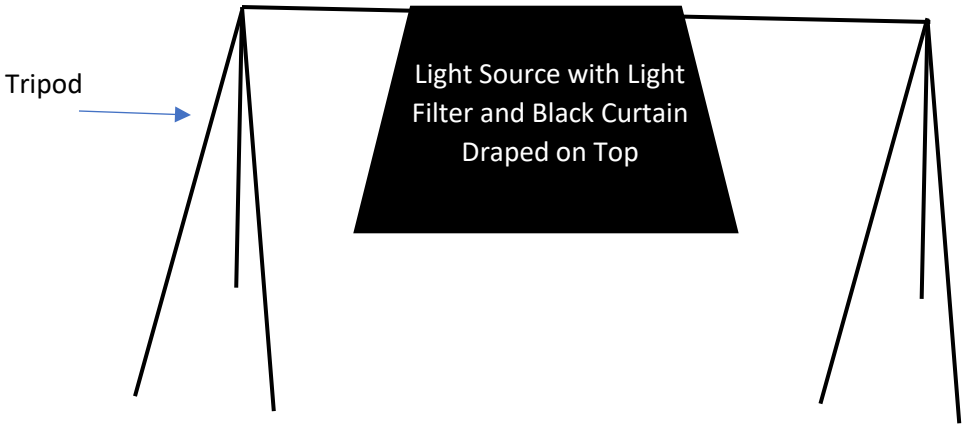

Figure 1: Experimental Setup

For our project, we needed to isolate the light source that was interacting with the surface of the bubbles we were imaging. To do this, we took two tripods and laid a third tripod across the middle of them, as seen in Figure 1. We then hung a stage light with a light filter from the third tripod and draped a black curtain over the top of the light. This provided the team an isolated light source to perform the experiment.

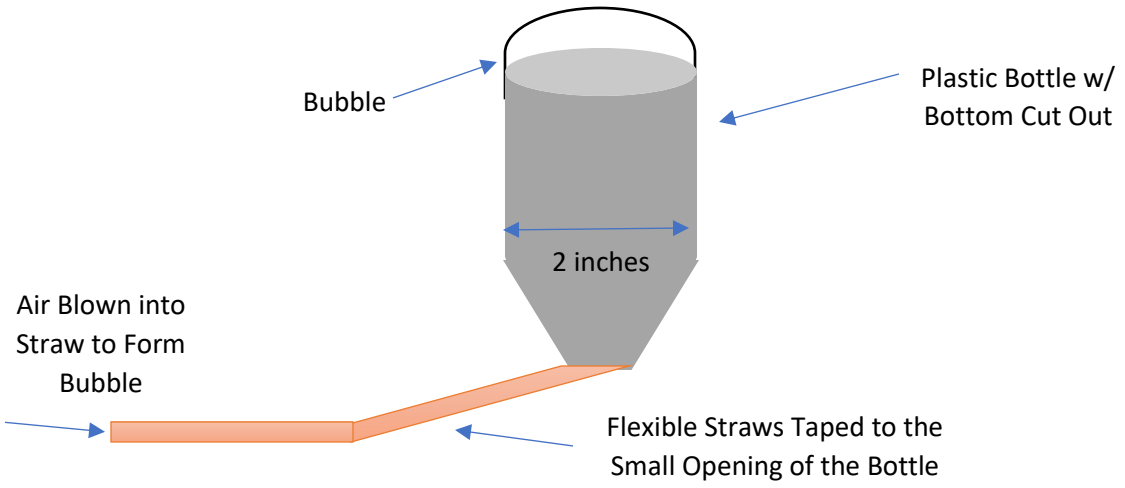

Figure 2: Bubble Blowing Apparatus

A chair was placed under the curtain to provide a surface for the bubble blowing apparatus to sit on, as seen in Figure 2. After the experimental setup was completed, a Canon EOS Rebel SL1 camera was placed on a tripod about 1.5 feet away from the bubble apparatus. This can be seen in Figure 3. While performing the experiment, we also turned off the lights in the room to isolate the light that we were using.

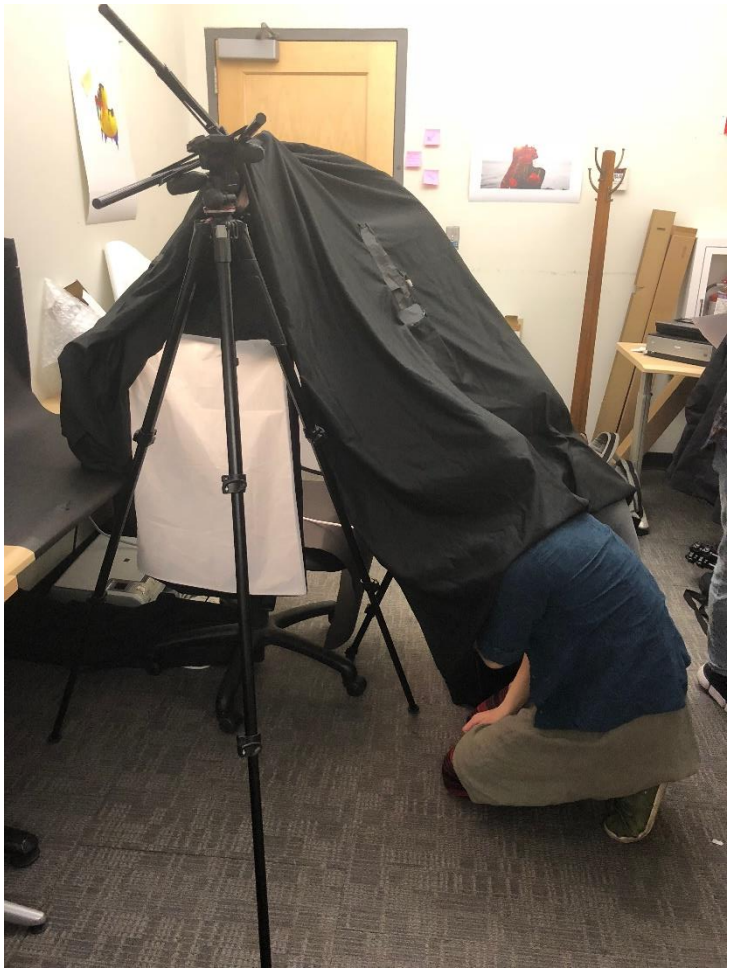

Figure 3: Camera distance and general setup

The experiment involved Lea Mattson holding the apparatus while dipping the top of the bottle in a Petri dish with soap in it that I was holding. Lea then moved the apparatus under the curtain and blew into the straw while Grace Wilson took the images. Chi Liu and Young Kim were in charge if turning off the lights in the room and provided different sources of light for the images throughout the project.

Fluid Dynamics

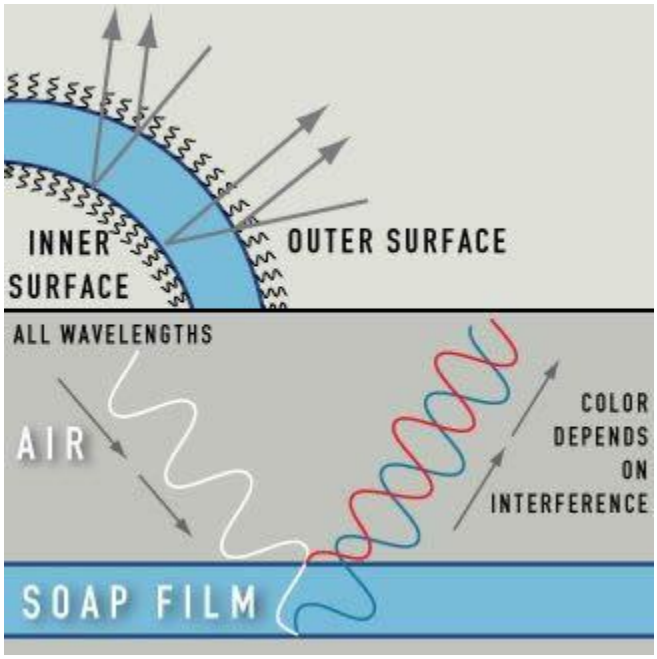

Figure 4: Light Reflections off Soap Film [1]

The light rays that are reflected off of the surface of the bubble, giving us the rainbow appearance, are waves that travel different distances. As the light hits the bubble, it reflects off the outside and the inside layer of the soap. If the reflected waves have the same wavelength, the observed color will be very vibrant, called constructive interference[2]. If they are not the same length it will be duller colored, called destructive interferance[2].

There are many reasons why the colors on the film of the bubble tend to change over time. The film thickness of the soap is constantly changing, which causes the distance that the wave is traveling to also change. The colors also change because light is hitting the film at many different angles. Each angle gives your eyes a different color as it is reflected. When looking at the soap film, the colors appeared to have motion as the bubble sat in the open air. This is because as the soap film sits, it evaporates, which causes the thickness of the soap film to change over time. Eventually, the observed soap film had no color to it, as all of the film had evaporated.

Visualization Technique

To get the proper lighting needed to see the color on the film of the soap, we used a single incandescent light bulb with a filter over it to provide soft lighting for the experiment. The rest of the lights in the room were turned off, and a curtain was used to block out any light that could be coming from outside the room. These conditions provided us great results for our images.

Photographic Technique

The camera, a Canon EOS Rebel SL1, was placed on a tripod about 1.5 feet away from the bubble apparatus as seen in Figure 3. We used focal length of 50 mm, a F-Stop of f/1.4, an

exposure time of 1/250 seconds, and an ISO-100 to capture our images. My original image had a size of 5184x3456 pixels. In Photoshop, I cropped the image slightly to focus on the top of the bubble, where the color could be seen. The final image is 2615x2744 pixels. I wanted to get an atmospheric look to my image, which is why I left the thin film at the top of the bubble in the edited image. I also slightly boosted the contrast of the image and sharpened the image slightly as well. These changes can be seen in Figures 5 and 6.

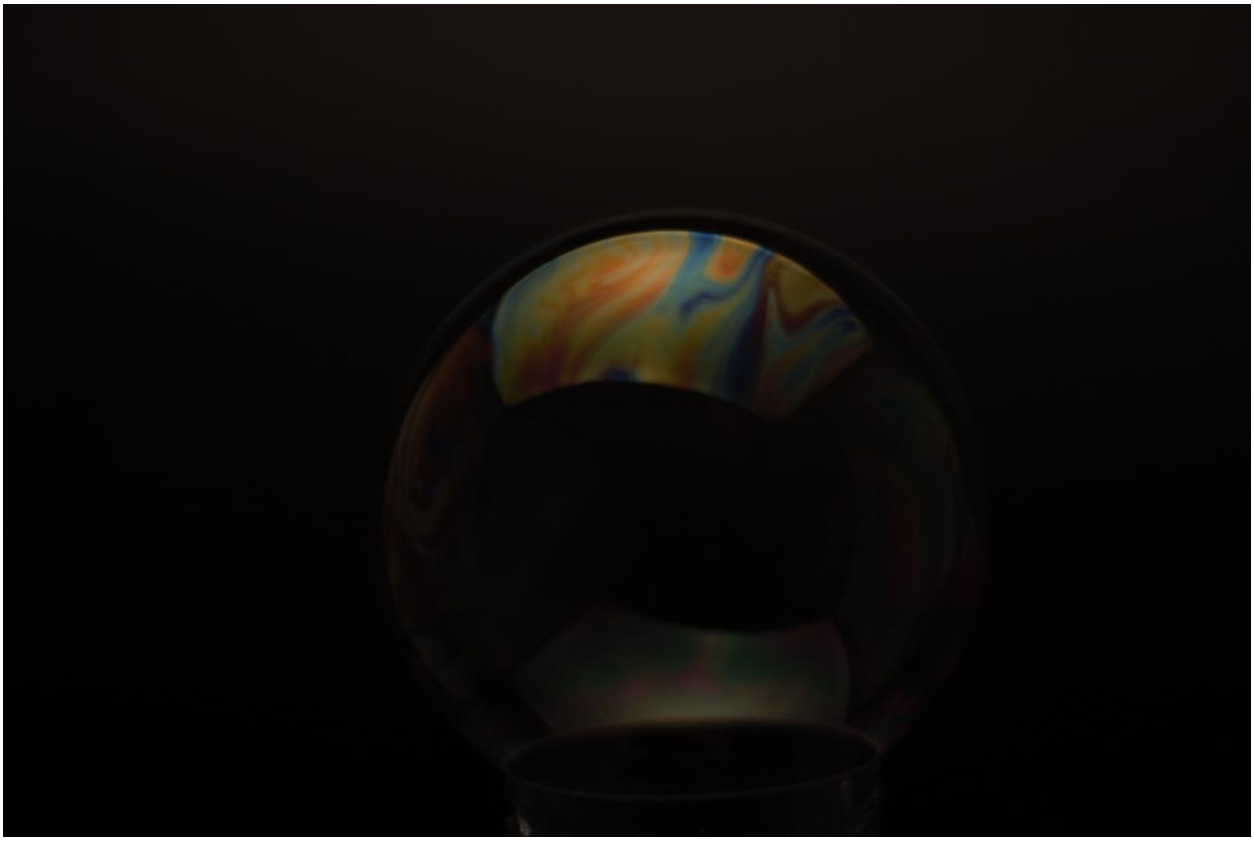

Figure 5: Original Image

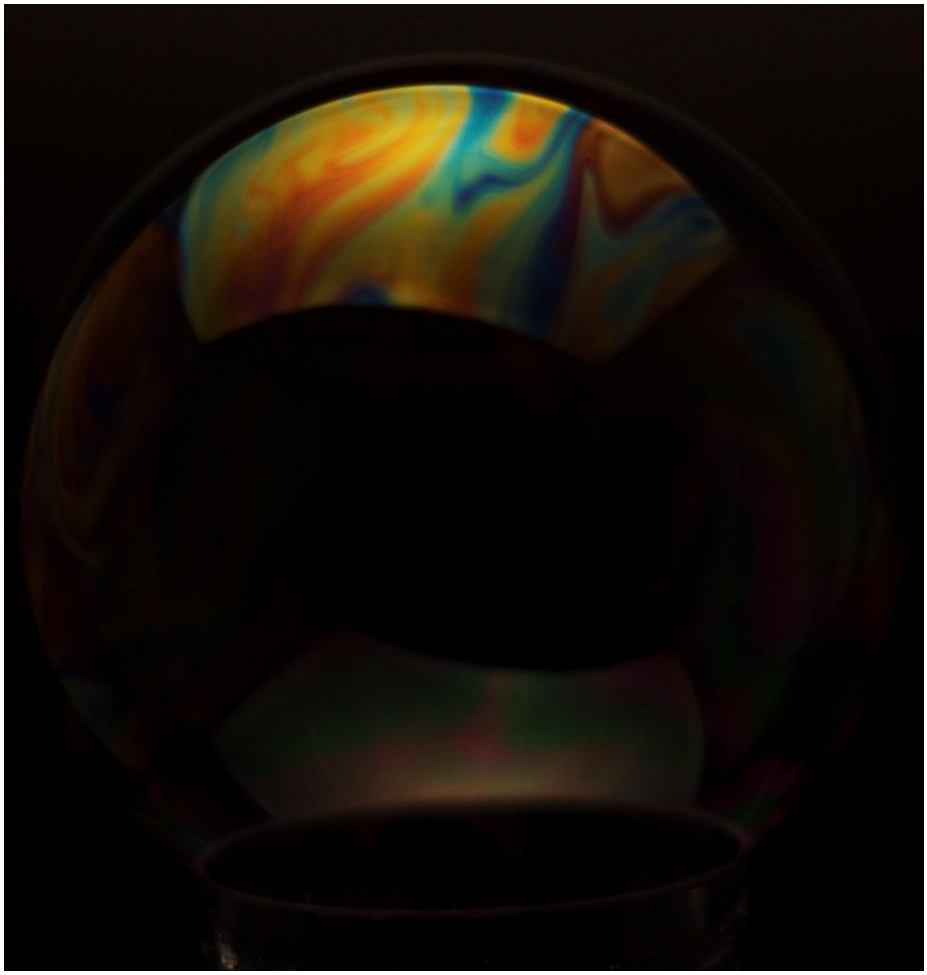

Figure 6: Edited Image

References

1 "Bubbles | Causes of Color." Bubbles | Causes of Color. N.p., n.d. Web. 09 Apr. 2018.

2 Tompkins, Eric. "Understanding Interference Patterns in Soap Films." Stony Brook Laser Teaching Center, n.d. Web. 09 Apr. 2018.