Team Third

Fall 2019

MCEN 4151-001: Flow Visualization

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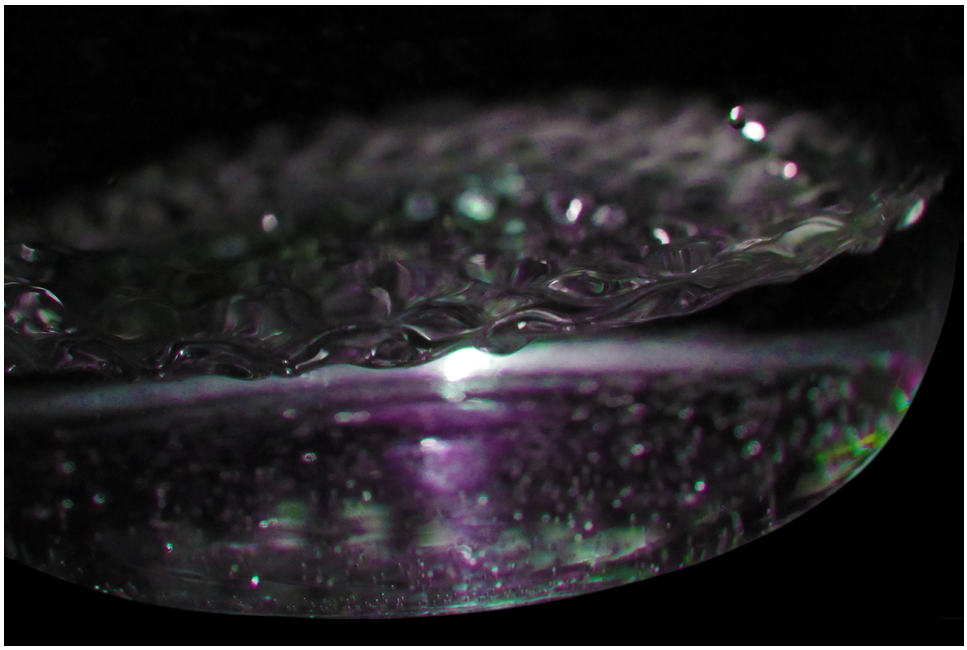

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INTRODUCTION

Much like the previous two team assignment, we had to collaborate together to capture an interesting flow phenomenon in an artistic sense. For this Team Third assignment, we decided to use a speaker with a glass of water on the speaker head to capture the reaction. The original plan was to use either paint or non-Newtonian fluid instead of water, but due to time constraint and lack of materials the team had to perform the experiment with water. Nonetheless, the experiment was still pretty interesting, and we had some really artistically beautiful results. Contributors who helped me in this experiment were Abdullah Alsaffar, Antonio Gueretta, and Salah Ammar.

EXPERIMET SET UP

The main materials we used here were simply the speaker, a small portable light and a glass of water, plus an app that is able to manipulate the output frequency of the speaker. The speaker we used was a small JBL Portable Waterproof Bluetooth Speaker that Salah had. The glass of water was borrowed from the ITLL staff. We started by filling a quarter of the glass with water (filling it with too much will produce negligible reaction) and placing it on the JBL speaker. We then turned all of the room light's off and started using the portable light that Antonio had. That portable light had the functionality of producing multiple colors including, white, red, and green. This was beneficial for our experiment as we were able to obtain distinctly different looking reactions. A sketch of the set-up is shown in Fig. 1.

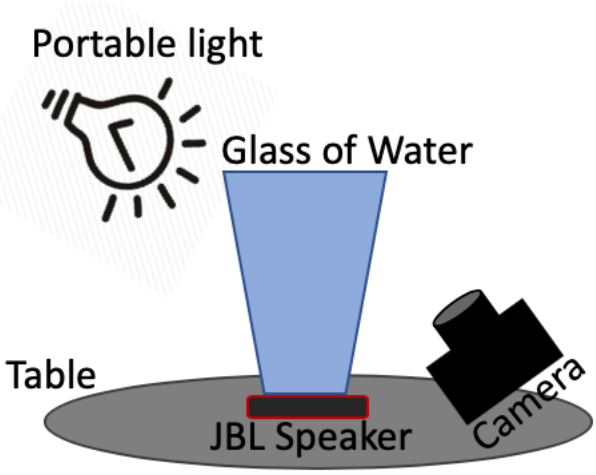

Figure 1. A sketch of the used setup for the experiment.

While the glass of water is on top of the speaker, we manipulated the sinusoidal sound wave frequency using an app called Audio Signal Generator. During that the glass must be held in place by someone to prevent it from sliding due to the vibrations produced by the signal. We circulated between each other's as a team of who will hold the glass, who will shine the light, who will adjust the frequency, and who will capture photos and videos. I used my usual Canon PowerShot SX530 HS camera, with lens 4.3-215.0 mm. The settings for the final captured image are: Focal Length: 9.322 mm | f number: f/4 | Exposure time: 1/800 | ISO: 1600. The distance from the camera to the glass was approximately 6 inches with a FOV of about 1 inch.

FLOW PHYSICS

Sound waves are considered acoustic waves, which behaves similarly to fluid waves. They propagate through some fluid medium, like water or air, and act as a variation of pressure. Difference is that water waves are easier to see and understand compared to sound waves. But, water itself can be used as a way to visualize those sound waves assuming the amplitude and frequency are enough for that. That's why the speaker was used here to help illustrating the phenomenon. Different patterns could form depending on a lot of factors, and the math and calculations for determining that are quire extensive and sophisticated. The patterns are called Faraday ripples [1]. These patterns are observed on liquids that are subject to some oscillation or vibration behavior, changing the surface from the normal flat state to an unstable state. Some of examples of these patterns are shown in Figure. 1. The phenomenon itself is called Faraday instability.

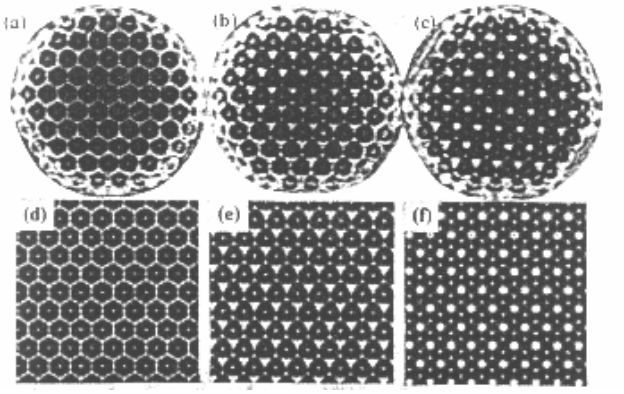

Figure 1. Some potential Faraday waves patterns.

PHOTO EDITING

Editing of this photo was done primarily using Adobe Photoshop CC 2019. First, I was unsatisfied with the original colors of the image. I thought it was kind of bland with no artistic feeling to it, so I applied the following settings in Photoshop as shown in Fig. 2.

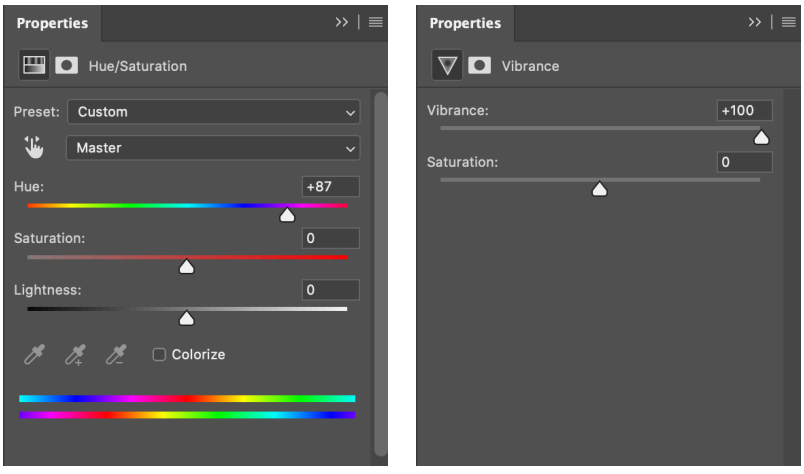

Figure 2. The saturation and vibrance settings used to adjust the colors.

Next, I wanted to remove some of the distracting elements like the glass labels and speaker in the background. To do this, I used the Spot Healing Brush Tool to replace and blend these spots with the dark black background. After that, I cropped the image to improve the overall framing of the picture. A comparison between the original and the final edited image is shown in Fig. 3.

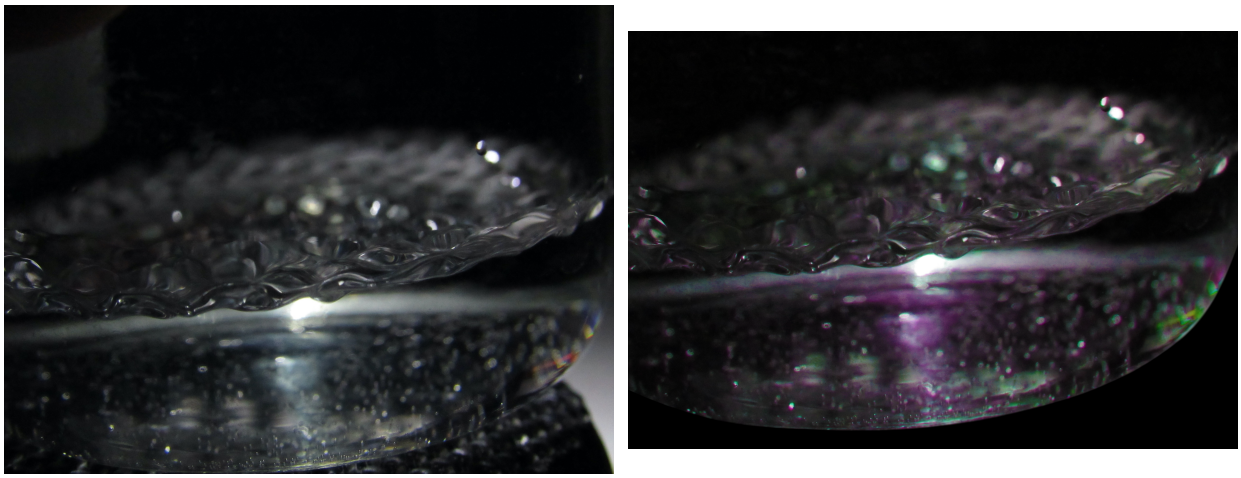

Figure 3. The original photo (left) vs. the edited image (right).

The dimensions of the final photo were 4608 px x 3080, with a resolution of 72 pixel per inch.

CONCLUSION

This experiment was tricky to do for our team because we had to get the picture done immediately after break and we had a poor plan of attach. Therefore, due to the lack of materials we had to change the substance used from paint or non-Newtonian fluid to just regular water. I believed the experiment would have been way more artistic and more sophisticated if a different fluid was chosen. All in all, I think post processing upped the image a bit and made it more interesting and presentable. One part that I'm not sure of is the black cut in the right-down corner. It might have been better if I left the speaker. It's really hard to decide since sometimes what we think is a distracting element actually adds more to the photo.

REFERENCES

[1] https://www.waterjournal.org/volume-9/sheldrake