Flow Visualization

Team First Report

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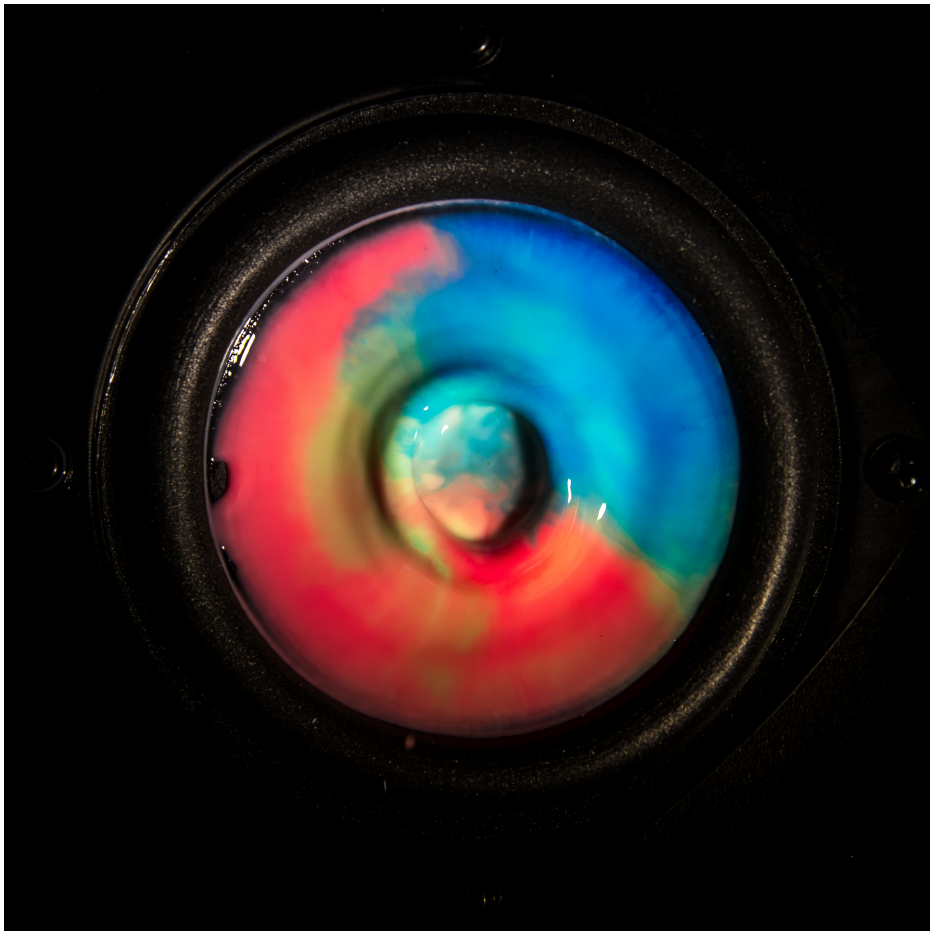

1 Introduction

The team first is the first chance we can work with the our team to setup some flow experiments. Unfortunately, I was not be able to meet my team due to the schedule conflict. Therefore, I have setup my own experiment with a subwoofer, milk and some water paints. During this experiment, the water wave is excites by the 20 Hz sound played through the subwoofer. In the following sections, I will introduce details of the experiment setup, the flow physics and the post-processing process.

2 Experiment Setup

The experiment setup as shown in the figure below:

- 4*1000 lumen living room lights pointing four directions(5400K white color)
- 900 lumen floor lamp pointing up (5400K white color)
- 450 lumen floor lamp pointing the speaker cone (2700K warm yellow color)

The camera I used is Sony A7RIII, the lens was Canon 24-70mm f/2.8L II lens, the image has the following properties:

- 70mm
- f/2.8
- 1/400 sec
- ISO 1000

Figure 1: Experiment setup.

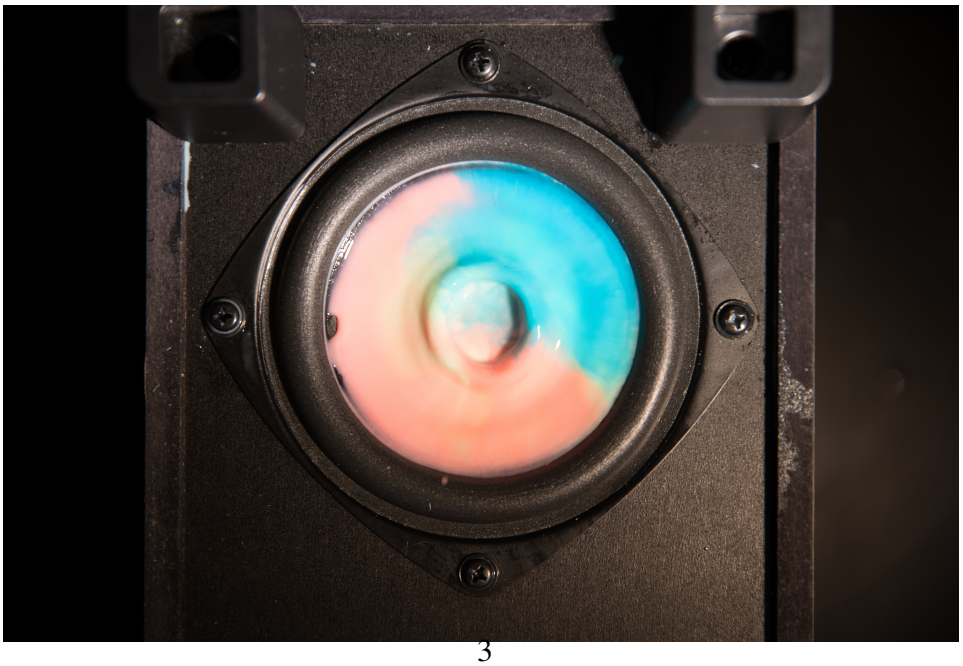

Figure 2: Original, untouched image.

The speaker is placed on the top of the table for maximum stability. Two 80/20 aluminum beam placed under the speaker to create the room the the wiring at the back of the speaker. Speaker cone is 4 inches in diameter and filled with milk up the edge of the cone. The camera is supported by the tripod in the horizontal orientation next to the table, about 35 cm above the fluid surface. There are three main light sources set up for this screen. I have used the maximum aperture f/2.8 on my lens to allow maximum lights into the camera, and shallow the depth of the filed.

3 Flow Physics

The flow physics behind this image is very interesting. This phenomena is known as cymatics, which is derived from the modal vibration phenomena. With certain levels of excitement, the wave are generated as all components of the system are affected sinusoidally. The frequency in which photo was taken was 20Hz sine wave. The moment is captured at the beginning of the water excitement. I tried with a wide range of the frequencies from 1 Hz up to 200 Hz and realized 20Hz create a good size of the wave without breaking into a mess of patterns. Limited to the size of the speaker cone, I wasn't be able to see the full pattern. For the future improvement, I would recommend a larger speaker cone.

4 Post Processing

For post processing, I first cropped image into 1x1 square shape so it is symmetric around the middle of the cone and cut of four distracting speaker stands. Increased the contrast, lowered the exposure. Lowered the black and shadows significantly to get rid of the distracting objects.

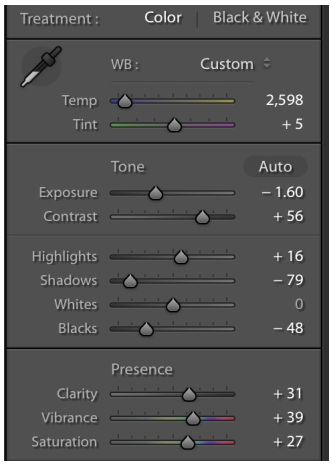

Figure 3: Lightroom editing screen shot.

To increase the vividness of the colors, I also played with the hue option in the Lightroom, as shown in the figure below:

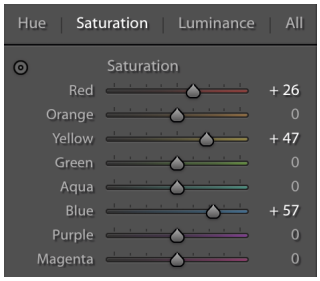

Figure 4: Lightroom editing screen shot.

5 Reference

http : *//www.cymascope.com/cyma*$_r$*esearch/history.html*