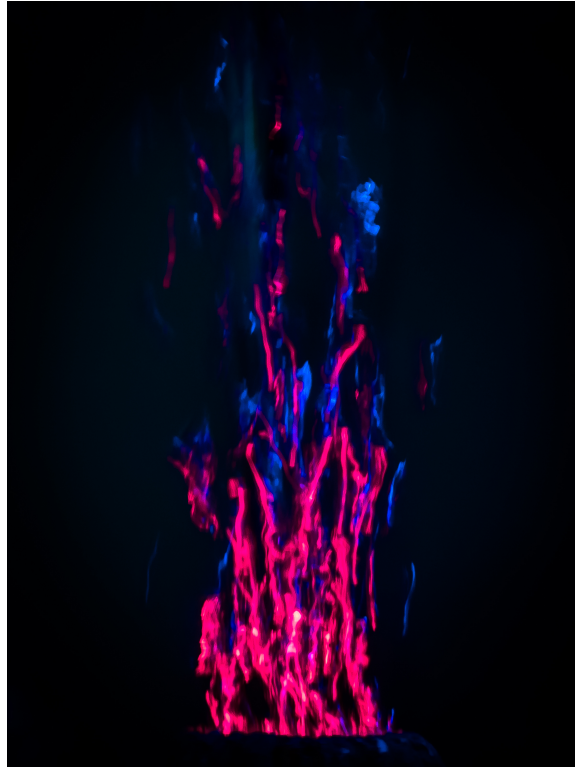


Flow Visualization

Get Wet Report

Hanwen Zhao

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1 Introduction

As the first assignment for flow visualization course, the idea is for us to "get your feet wet", play with the flow and take a shot of it. For this assignment, I took a picture of air bubble came out from an air bubble stone. In this report, I will discuss the experimental setup, the flow physics behind it and the image post-processing.

2 Experiment Setup

The fish tank I have is an 29 gallon fish tank, as show in the image below.



Figure 1: Fish tank overview

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

- 55mm
- f/2.8
- 1/30 sec
- ISO 640

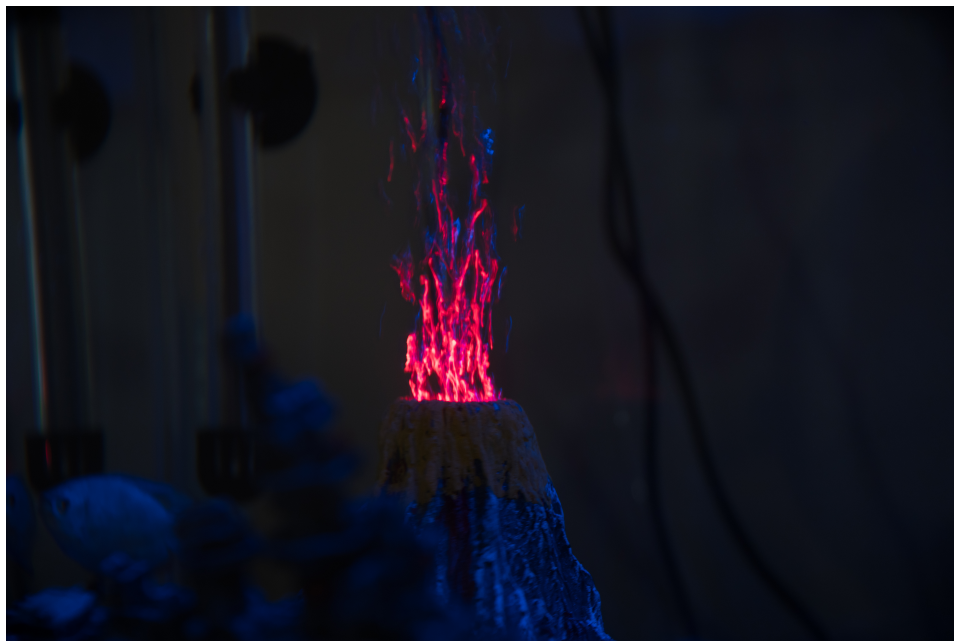


Figure 2: Original, untouched image.

There are two light source for the air bubbles, the first one is the red LED light at the bottom of the volcano decoration, and the blue LED came from top of the fish tank, a better view can be seen from the fish tank overview picture. The camera was hand held since I didn't have my tripod set up. I used the maximum aperture available on the length which can decrease the shutter needed. I played with several different shutter speed from 1/10 to 1/100 to see which one can create the best motion blur of the air bubbles.

3 Flow Physics

Interestingly, those bubble won't react with water like people normally think, the air stones are not really aerating the fish tank water. The process of aeration is secured by waves that are created as air escapes from the stone. Therefore we can actually calculate the speed of the air bubbles from the image.

From the very basic speed and distance equation:

$$v = s/t \quad (1)$$

The shutter speed was 1/30 s, which means the length of the motion blur created by the air bubbles have the travel time of 1/30 s. After measuring the opening diameter of the volcano decoration of 3.6 cm, we can use it as the reference to calculate the travel distance of air bubbles.

$$\frac{D_{volcano \text{ in image}}}{D_{volcano \text{ in reality}}} = \frac{S_{bubble \text{ in image}}}{S_{bubble \text{ in reality}}} \quad (2)$$

Take a clear motion blur at the bottom right, we can calculate the actual distance is 2.208 cm, with the 1/30 shutter speed, we can calculate the speed of the air bubbles:

$$v = \frac{2.208 \text{ cm}}{1/30 \text{ s}} = 66.24 \text{ cm/s} \quad (3)$$

4 Post Processing

For post processing, I first lowered the image temperature so it creates a cooler feel on the blue colors, decreased the exposure a little to get ride of the distracting background. Increased the contrast a lot so that it highlights the blue and red colors. Also some tuning on highlights, shadows etc. to make the motion blurs more clear.

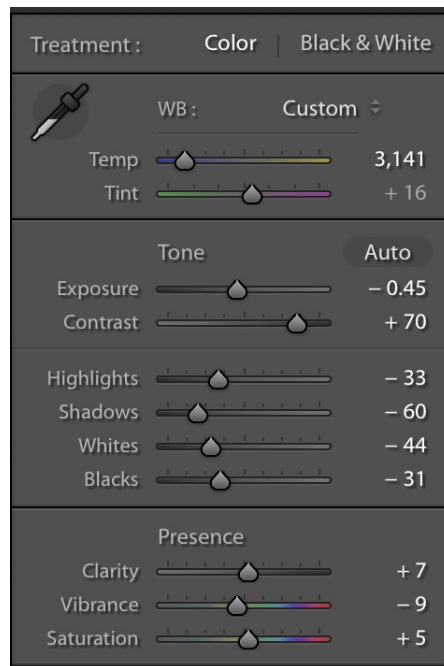


Figure 3: Lightroom editing screen shot.

5 Reference

<https://en.aqua-fish.net/articles/guide-forum-suppliers-aquarium-air-stones>