MCEN 5151: Second Team Assignment Report

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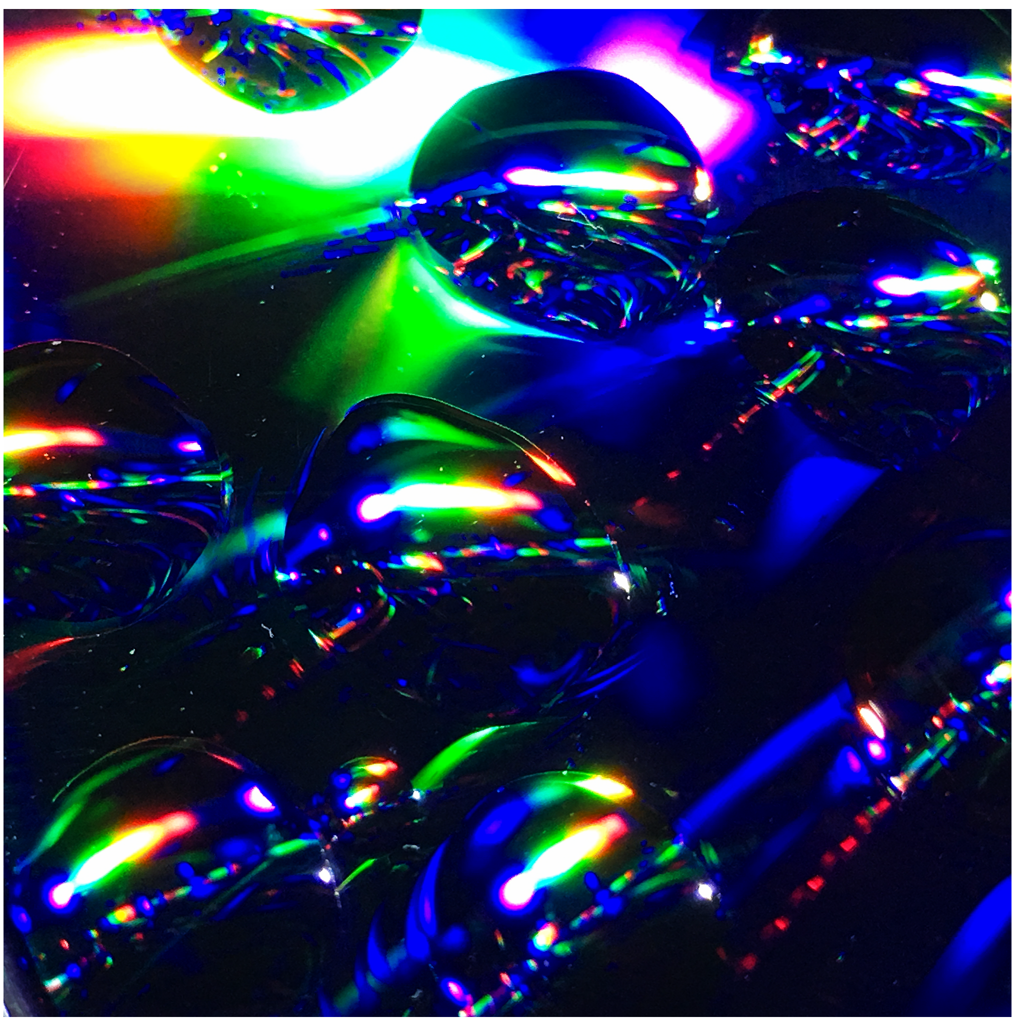

1. Introduction

This report is a general overview of the second team assignment on MCEN 5151 Flow Visualization. This assignment was intended to provide a stage where students can work together on things that they are interested in and gain some practical experience on imaging techniques and scientific observation. For the second, Alex and I made something special: we used a compact disc as a background and took images of water droplets on the disk.

2. Image Basics

Reproducing an image like the one we did cannot be easier. The CD we used to make this image was almost in mint condition; there were neither scratches nor abrasions on the surface, making it a perfect background free of distraction. In lieu of the built-in flashlight on the phone, we used a headlamp as the light source, which rendered a brighter, more satisfactory illumination. We kept switching the angle at which the headlamp was face the disc and tried to find the best one out of it.

3. Fluid Physics

In order to figure the physics behind the image, it is extremely necessary to explain why the compact disk reflects rainbow colors. In fact, the rainbow colors on the CD remind me of the same pattern that soap bubbles show. An analogy can be drawn between a compact disc and a thin film of oil floating on water. When the incoming ray of light strikes the film, most of it passes through the film while some is reflected off the top and bottom layers of the film. The light that reflects off the top travels a shorter distance than the light reflecting off the bottom. [1] This is thin-film interference, a natural phenomenon in which light waves reflected

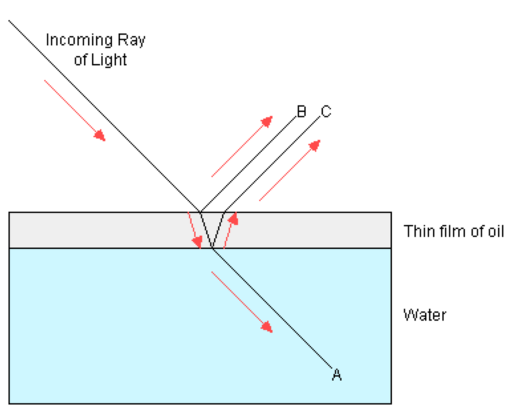

Figure 1: Demonstration of the optical path length difference for light reflected from the upper and lower boundaries of a thin film.

by the upper and lower boundaries of a thin film interfere with one another to form a new wave. Interference patterns appear as colorful bands if the incident light is broadband or white. [2] On a CD, as its surface is mirrored, the reflection can be maximized and the rainbow colors are much more intense.

4. Photographic Techniques

To get the most favorable image, the key is to keep switching the positions of the camera and the position at which most rainbow colors can be observed is one that I am looking for. Another important trick that is worth mentioning is that the headlamp should be held far enough from the disc. Because the surface of the disc is like a mirror. If the headlamp is held too close to the disc, the beams emitting from the lamp will be subject to overly intense reflection, which overwhelms the effect of interference. Post-processing wasn't a key step when I made the image because of the high contrast. What I did was just to adjust its sharpness and increase the clarity.

5. Conclusion

This image reveals an interesting, common optical phenomenon. Rainbow colors created by thin-film interference are "swallowed" by the droplets evenly scattered on the surface. It is just fascinating. But this image still has room for improvement. The dusts on the surface are the main distraction. In general, the image demonstrates what we were trying to observe and the physics behind.

6. References

[1] HowStuffWorks. (2000, April 1). Why do CDs reflect rainbow colors? Retrieved November 7, 2016, from http://electronics.howstuffworks.com/question52.htm

[2] Thin-film interference (2016). . In *Wikipedia*. Retrieved from https://en.wikipedia.org/wiki/Thin-film_interference