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Team Third
Flow Visualization 4151-003
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Schlieren Imaging

For my Team Third project, Cooper, Travis, and I wanted to take some decent schlieren images with Dr. Hertzberg's setup. We had different setups involving candles, matches, and lighters. I ended up going with a very simple route and just holding a lighter between two of the mirrors. There was a lot of trial and error with many blurry images. I had a lot of trouble getting my lens to focus on the subject, even after holding up a static object in the area that I was trying to capture. I thought that I was seeing motion blur at first, but I was still getting blurriness at $1/4000$ of a second shutter speed. The best I was able to get unedited is shown in **Figure 1**.

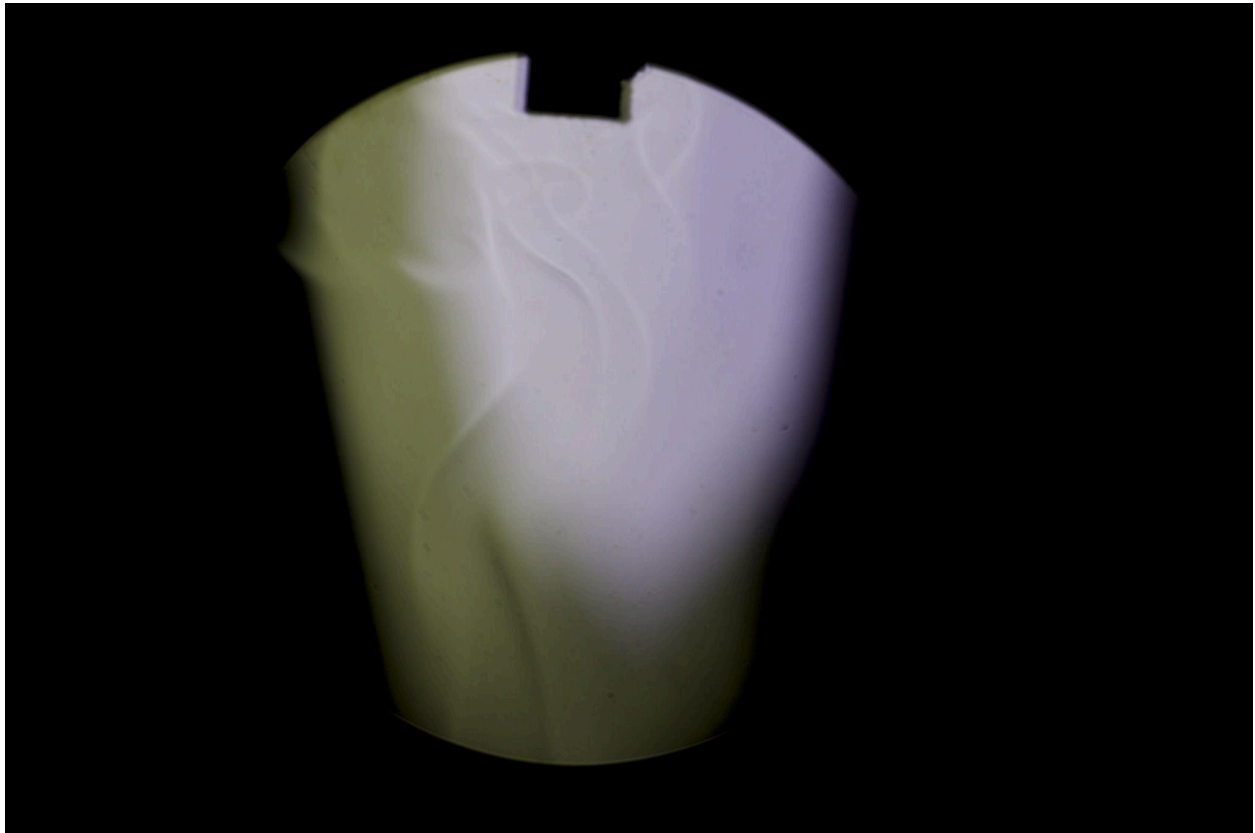


Figure 1: unedited image of flame

The apparatus we used to do our schlieren imaging, shown in [Figure 2](#), was borrowed from Dr. Hertzberg. We used a small flashlight to shine a beam through many different heat sources. The one I ended up using was a Bic lighter. The light refracts through the heat coming off of the lighter. The refracted light reflects off of the next mirror and goes past a razor blade which helps to focus the image into the camera. Schlieren works because light rays bend when they “encounter changes in density in a fluid” (Nasa). The light reflected from the first mirror becomes “parallel rays” which are focused by another mirror toward the camera lens (Nasa). The light that passes the razor blade shows up as different “shades of gray corresponding to differences in density” (Rolfe, 2015).

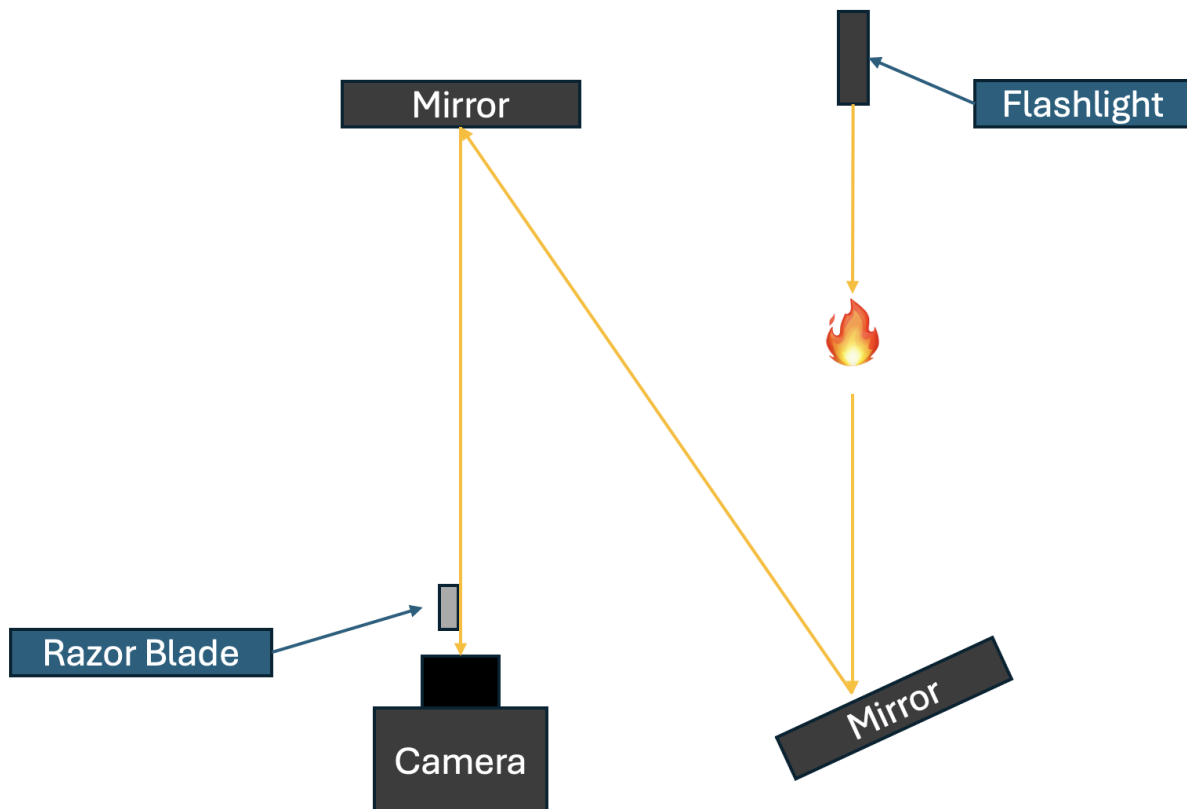


Figure 2: our apparatus for schlieren imaging

The visualization techniques that we used were pretty rigid since we couldn't really change the setup at all. We tried putting a lot of different things between the 2 mirrors, but I liked the look of the lighter the best. To focus the image, we used a bottle

of olive oil. The distinct bubbles in the oil were very easy to focus on. We also turned out all the lights in the room because we could see the waves more clearly.

I took my picture on my Canon 77D DSLR. I used a 135 mm zoom on my Canon 77-200 mm lens. My shutter speed was 1/4000 of a second, which is the lowest I can make my camera go. I was at an F-stop of 18 and 1600 ISO. The resolution for raw, unedited image is 6000 by 4000 pixels. The resolution for my edited image, [Figure 3](#), is 5311 by 3541 pixels. The mirror was about 4 feet from my lens, and the field of view was about 8 inches.

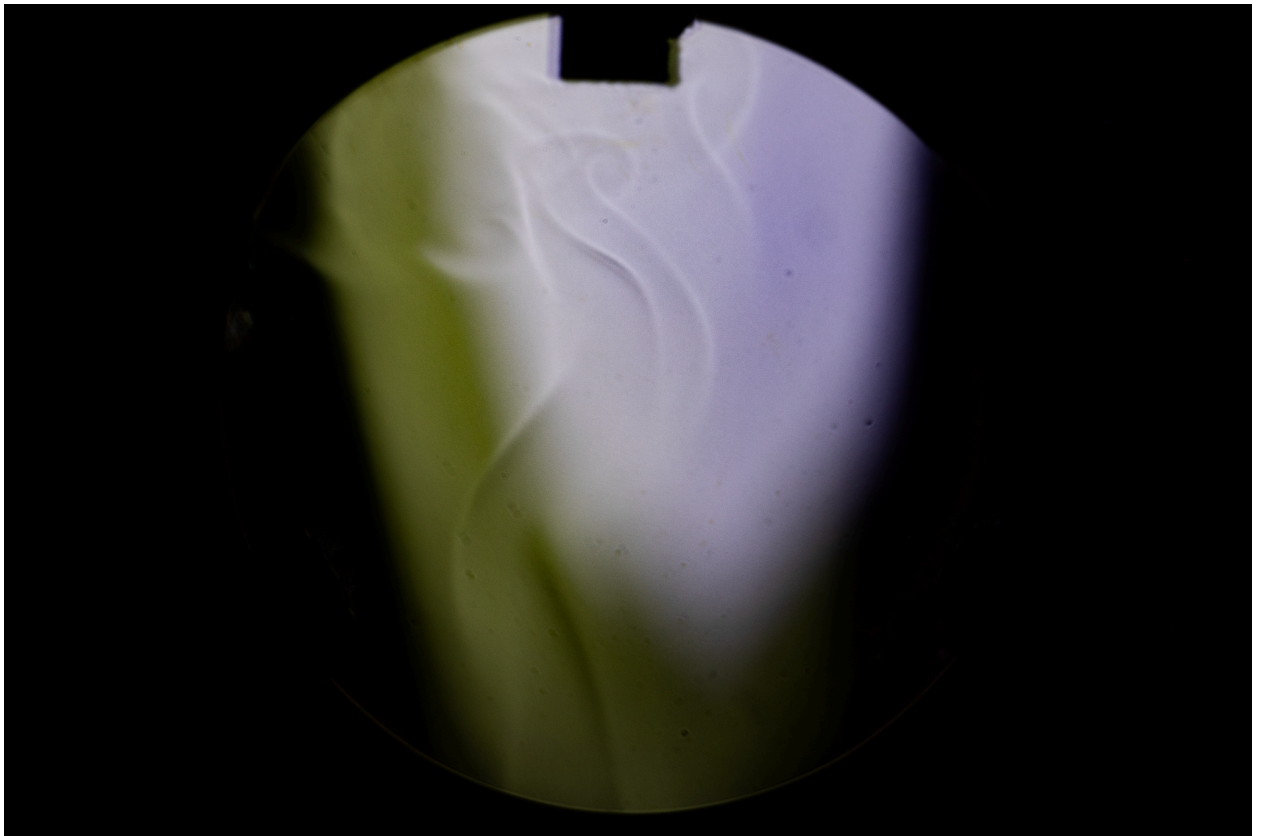


Figure 3: edited image of flame

I think my image is a good representation of schlieren imaging for what I have the capability to do. I think the little wisp in the middle of the image is very pretty which is ultimately why I chose it out of the many photos that I took. I think the image has kind of a mystical look to it. It reminds me of a lot of the effects used in *Wicked*, which was my favorite movie that came out this year. I think I could probably improve this image through a lot more trial and error, but as of now, I think I'm happy with where it's at.

Works Cited

Rolfe, B. 2015, *Schlieren Imaging: How to See Air Flow!*, Autodesk Instructables,
<https://www.instructables.com/Schlieren-Imaging-How-to-see-air-flow/>

Schlieren System, National Aeronautics and Space Administration,
<https://www.grc.nasa.gov/www/k-12/airplane/tunvschlrn.html>