

Team 2

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Introduction

The above image is of the smoke coming from a burning incense stick. It was taken on October 30th inside Tim's lab at ECME 165. Team members included Stephanie Mora, Tianzhu (Tim) Fan, and Yadira Valadez. Stephanie had the idea of trying to capture a Kelvin-Helmholtz instability after seeing the phenomenon from her incense burner. My photo itself did not capture this instability that well but we did see them while trying to capture a photo but none of the shots I took came out to my liking but I found the photo I chose to still have an interesting flow worth showing off.

Apparatus and Set up

The apparatus was fairly simple to set up with only using a black background that contrasted well with the white smoke coming from the incense burner. The incense burner we used was a standard stick incense burner that held an incense stick at an acute angle as it burned. The flow seen in the picture starts at the bottom with a laminar flow that you can see expands into a turbulent flow where the smoke starts to curl and become less predictable. A fluid, like smoke in this case, can be described as either being laminar or turbulent by calculating a Reynolds number with the below equation

$$Re = \frac{UD}{\nu}$$

Where U is the speed of the smoke, D is the distance traveled and ν is the kinematic viscosity. We can calculate the kinematic viscosity with the equation

$$\nu = \frac{\mu}{\rho}$$

Where μ is the dynamic viscosity of the smoke and ρ is the density of the smoke. As you can see as the distance the smoke travelled (D) is increased then the Reynolds number will also increase if we assume a constant velocity which I think we can because of the still air the smoke passed through.

Visualization and Photographic Techniques

To help visual the smoke the team used a black backdrop as we felt like it would contrast well with the white smoke. The tricky part of this was trying to predict where the smoke was going to form from the incense. The room we took the picture in didn't have any kind of noticeable air flow from a fan so any sort of movement from the smoke is from its own physics from the transition stage of laminar to turbulent flow. The lighting was also just from low-level overhead fluorescent lighting. We wanted to be able to get a shot of the smoke without a shadow on the backdrop so overhead lighting was the preferred choice and I feel like it worked out well for us.

The camera I used was a Canon EOS 30D with a 1/250 shutter speed, f/20 aperture, 250 ISO speed, and a focal length of 45mm. With a distance of the camera being approximately a foot from the rising smoke I find the field of view to be nearly 6 inches across. This was also shot using a tripod to eliminate camera shake that I felt I had in my original image.



Figure 1: Original image (left) to Post Processed image (right)

Above in figure 1 are the original photo and the post processed photo. As you can see in the original image, the black background had a lot of scratches that needed to be removed via photoshop. I also removed the incense stick with the clone stamp and darkened the background to solid black. I put a purple hue on the smoke as well for aesthetic appeal just because I thought it looked better than keeping it the white smoke. I wanted to keep the smoke the main focus of the image.

Conclusion

I was happy with the way the photo turned out even though I wasn't able to capture the Kelvin-Helmholtz instability that my goal was to do. For improvements on the photo I would try using a higher ISO speed because the room was not as well lit as expected. At the time of taking the photos I felt I could have gotten away with just a 200 ISO but it was later recommended that I try it with a higher speed to be able to get a sharper and clearer photo.