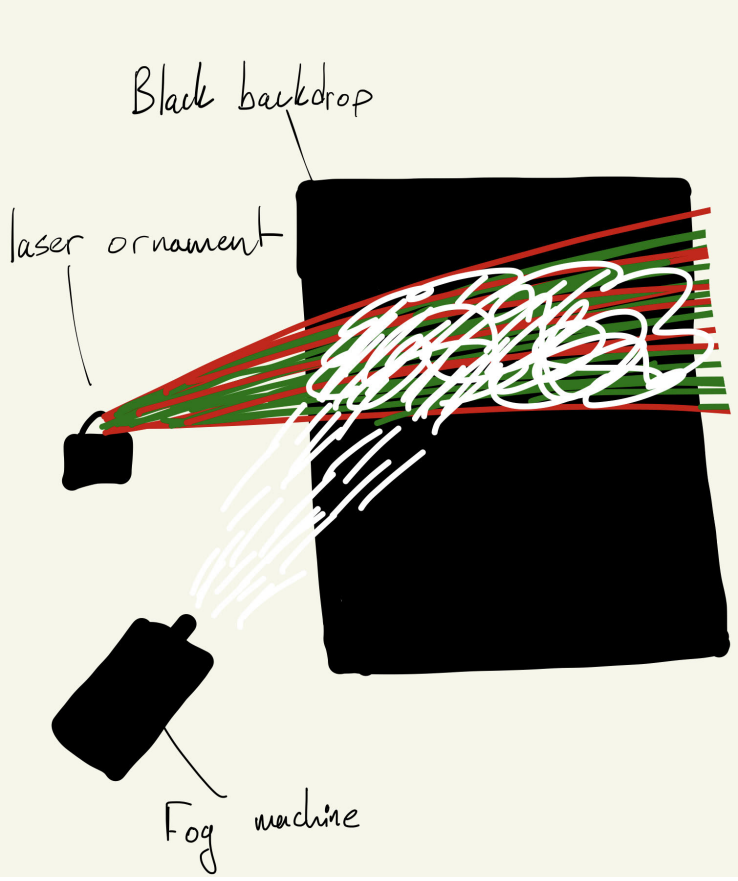
John Whiteman
ATLS 4151-001
October 10, 2022
Collaborators: Bryce Dickson, Tobin Price, William Watkins

This was the visualization of the semester and our group chose to work with lasers from a lawn ornament and fog from a stage-fog machine. The intent of our experiment was to document the differences between the fog in a laminar and in a turbulent flow state, as well as observe the transition from one state to another. The lasers are used to illuminate these phenomena in a flashy way and the added colors make the flow of fog much more attractive. A big thanks to Bryce for bringing the laser ornament and to Tobin for checking out the fog machine and letting us use his garage. Below is a sketch of the apparatus we used to capture the flow.



To capture these images we set up the laser machine in a dark garage with a black backdrop and used the stage-fog machine to disperse the fog into the lasers. The machine blew

the fog out with a lot of force so we intermittently turned it off and back on again to allow the fog to settle for a bit and capture a laminar state. The only forces acting on the fluid/flow in this instance were the air currents in the garage (created by the fog machine mostly, but also other factors like breath and movement), and gravity. These forces seem rather small, however, they are enough to generate some really interesting flow-physics and combined with the lasers they made for some really interesting pictures. The laminar flow state can be observed in the video when the fog particles begin to have a more uniform appearance as the layers of particles are moving together and not causing too much disturbance to the other layers[1]. The turbulent flow can be observed when the fog starts moving faster and much less predictably[1][2]. We can know these states are turbulent because the different layers and particles of fog are all intermixing and flowing all over the place[2].

Fog can be hard to observe clearly, but the technique we used to color the fog using lighting from the lasers allows us to track layers of particles and individual particles and more easily understand the flow in front of us. We shut the garage we were in and turned the lights off, making it so the lasers were the only source of light present in the garage. I particularly liked this technique because it allowed us to completely disregard the background and any light that was captured came directly from the flow being observed.

The field of view in this video is approximately four feet wide by two feet tall, and the distance from the fog to the lens was about a foot and a half. It was shot using an iPhone 13 Pro Max's wide camera that has a focal length on 26mm. The shooting and playback framerate is 30 frames per second and the video dimensions are 3840x2160 pixels.

I really enjoyed capturing this flow and I love the parts when the fog is settling into more of a laminar-flow state and you can see the streams of particles moving together. Of course it's also interesting to see how the stream of flow coming from the machine can greatly disrupt the settling particles and erupt the flow into a very unstable turbulent state. I think the fluid states are depicted well and it's a joy to visualize the transition between states. The brightness and contrast values of the video were adjusted to better reflect the fluid flow being visualized, both pre and post-edit videos can be accessed below.

Post-edit: https://vimeo.com/752378900

Pre-Edit: https://vimeo.com/758911432

References

[1] Britannica, The Editors of Encyclopaedia. "laminar flow". *Encyclopedia Britannica*, 24 Aug. 2022, https://www.britannica.com/science/laminar-flow. Accessed 10 October 2022.

[2] Britannica, The Editors of Encyclopaedia. "turbulent flow". Encyclopedia Britannica, 5 Feb. 2020, https://www.britannica.com/science/turbulent-flow. Accessed 10 October 2022.