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MCEN 5151 - Flow Vis

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Get Wet Assignment

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Get Wet Report

Get Wet assignment was to get students a feel of anything flow related either air or water or other mediums. This is the first test assignment for students to practice on. This is the first major assignment for the 2023 fall semester. The requirements are wide, to demonstrate anything flow related and can be captured by camera. I was trying to show the airflow around a hot wheel toy car, unfortunately after spending more and more time, I found out it would not work based on my setup of a 1:43 car model and inadequate equipment to properly demonstrate the flow clearly around the car. I gave up that idea and moved onto this final image using the display box the hotwheel car came with. I set the fog into the display box by using a fog machine, then waved my hands between camera and the box quickly one time then captured the image. The intent of the image is to show the flow around the display box with an upward airflow. I planned to capture the vortex it created on the inside edges of the box and which directions the fog will go after passing the edge of the box.

I have used some simple equipment including a black shirt ironed out as background, a desk lamp at the bottom of the display box as the only light source, a hot wheel display box, and a fog machine. I set everything up in a completely dark room. The camera is a Sony $\alpha 7R$ II set on my tripod. Tripods provide more freedom for me to set everything else up in time by myself. There are only two types of fluid including air and fog generated by a fog machine. Fog is denser

than air, it has a tendency to drop down lower than air. Because of the density difference between fog and air, the fog sunk into the bottom of the box. However, the density is not drastically different which allows the air and fog to move independently from outside sources. I waved my hand from bottom to top of the display box to generate air flow and observe the differences. There are some vortices on the left side of the box, the right side has not moved much, from the top of the box, there are also some vortices. There are vortices on both sides from the path my hands went through. Since this is the first introductory assignment to get our feet wet in capturing the flows, there is no technical data I have collected that can be used to estimate the non dimensional scales. There are both turbulent and laminar flows shown in the picture. There are also some flow instability including Rayleigh-Taylor Instability¹ and Karman Vortex Street². Rayleigh-Taylor instability was from a different density of two fluids that interacts with each other and they are moving towards the denser fluid. Karman Vortex Street is when fluid is interpreted by an outside source that creates vortices. This happened when I waved my hand around the box and vortices were created behind the path of my hand.

The visualization techniques used are simple, it's only smoke mixed with invisible air to show the flow. The smoke was generated by a fog machine from Amazon which turns fog juice into fog by heating up the juice. It's an off the shelf item that can be obtained easily. The studio is set in a completely dark room with no light source or any other light flow to ensure the only changing variable is the smoke. This way is easier to demonstrate and adjust as I experiment for the best result. The only light source I used is a table lamp under the display box.

My camera was set on the tripod around 16-18 inches away from the display box. Focal length for this picture is 70mm with shutter speed of 1/80 and F/4.5, ISO 100. The camera is a mirrorless Sony α 7R II with 24-70 mm f/4 lens. The original picture has a width of 7952 pixel

and height of 4472 pixels and resolution of 300 pixels/Inch. The final edited image is the same size but more distorted and rotated, the word press requires a lower pixel count of 1400 for uploading purposes. The image was distorted and rotated.

Image revealed the air flow in a controlled environment with only one light source and only one outside flow motion, the effect on the somewhat stationary air showed the full effect of the controlled variables. My favorite would be the vortices on both sides of my hands' path, those vertices are not perfect, but they are there and can be seen clearly. At first I found the lighting to be too bright and a bit distracting, but from the critique section, people seemed to like it. The fluid physics are demonstrated especially with vertices and fluid instability. Even though it is not my intent to make it, the results are good and achieve what this assignment is looking for. I still would like to build a small scale wind tunnel to finish my air flow around a hot wheel F1 car, some classmates have amazing visuals showing with vibrant colors, I think that would be something I can work on as well.

¹H.J. Kull, "Theory of the Rayleigh-Taylor instability," Physics Reports. Vol.206 (1991)

²J.E. Cooper "Aeroelastic Response," Encyclopedia of Vibration. (2001)