Team First Report
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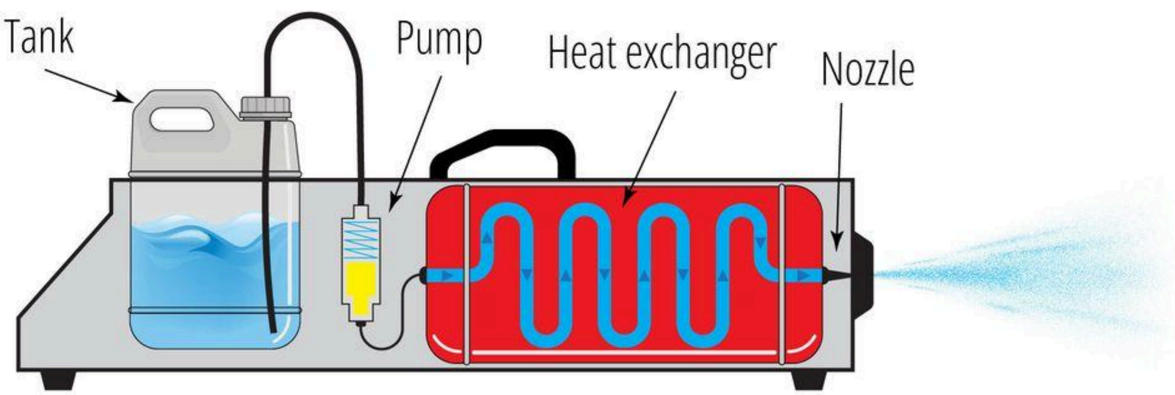
We checked out a fog machine and intended to use a laser plane with it, but it was unavailable, so we decided to find another way to visualize vapor flow. We used the men's bathroom in the basement of the DLC building on campus, because it was dark and isolated enough to capture the fog. There was a vent in the ceiling of the bathroom which was pulling the fog upwards and to the left from the perspective of the camera frame. We took many pictures with both our phones and cameras, and a couple videos. I eventually settled on a slow motion video I took with my phone. Cooper was operating the fog machine and Kai and I were taking the pictures.



The flow of the fog about the geometry of the room is outside the scope of the video, so it's only valuable to mention the movement within and directly outside the fog machine. As can be seen from the diagram above, the fog is forced through a nozzle before leaving the machine, which increases its velocity and decreases its pressure. The flow of the fog upon leaving the machine is turbulent, and then subject to existing pressures in the outside air, in this case the vent fan in the ceiling and the pressure coming from the crack in the threshold under the bathroom door. You can see in the video that the fog billows up in the middle of the frame before dispersing to the left. The viscosity of fog machine fog is dependent on the ratio of water to glycerin in the fog liquid. The liquid we used had a higher ratio, and the heating element in the machine was failing, which resulted in admittedly thin and less viscous fog. It is also hard to come up with a single viscosity for fog because in most conditions it acts as a non-newtonian fluid, where the viscosity changes with shear force applied. If we use the viscosity of air, however, when calculating the Reynold's number (around 1.8e-5), we can use the equation $Re = \frac{\rho V L}{\mu}$, a nozzle diameter of 2 cm, an exit velocity of 10m/s, and an air density of 1.2 to find a Reynold's number of 13,333, which is well above the threshold for turbulent flow, as predicted.

The most interesting aspect of this video, I think, is the motion extraction I used in the edited video, which is the best way I've found to visualize fluids with a poor camera and without an advanced setup. Firstly, the video was shot on a Samsung Galaxy s25 with the slow motion function, enabling higher frame rate video. The camera used was a 10MP, f/2.4 telephoto camera, the narrowest angle camera of the three front facing cameras on the phone. The fog was illuminated from below by Cooper's phone flashlight. The motion extraction seen in the video is achieved by duplicating the video track in my video editing software (in this case Premiere Pro '22), turning the opacity of the top track to 50%, and inverting it. The two tracks now cancel each other out, and the whole frame appears grey. Motion is extracted by moving the top track forwards slightly, and all motion which occurs in the delay between the two tracks is more or less highlighted. In the video, this is most obvious with fog of course, but is also (accidentally) applied to the pair of legs in the background, as well a couple specks of dust floating by. The unedited video is included at the beginning of the video for contrast, and it transitions to the motion extracted one.

https://youtu.be/3a8PFYeCApE

References

https://www.grc.nasa.gov/www/k-12/airplane/reynolds.html

https://www.thomannmusic.com/onlineexpert_page_fog_machines_translate_funktionsprinzip.html