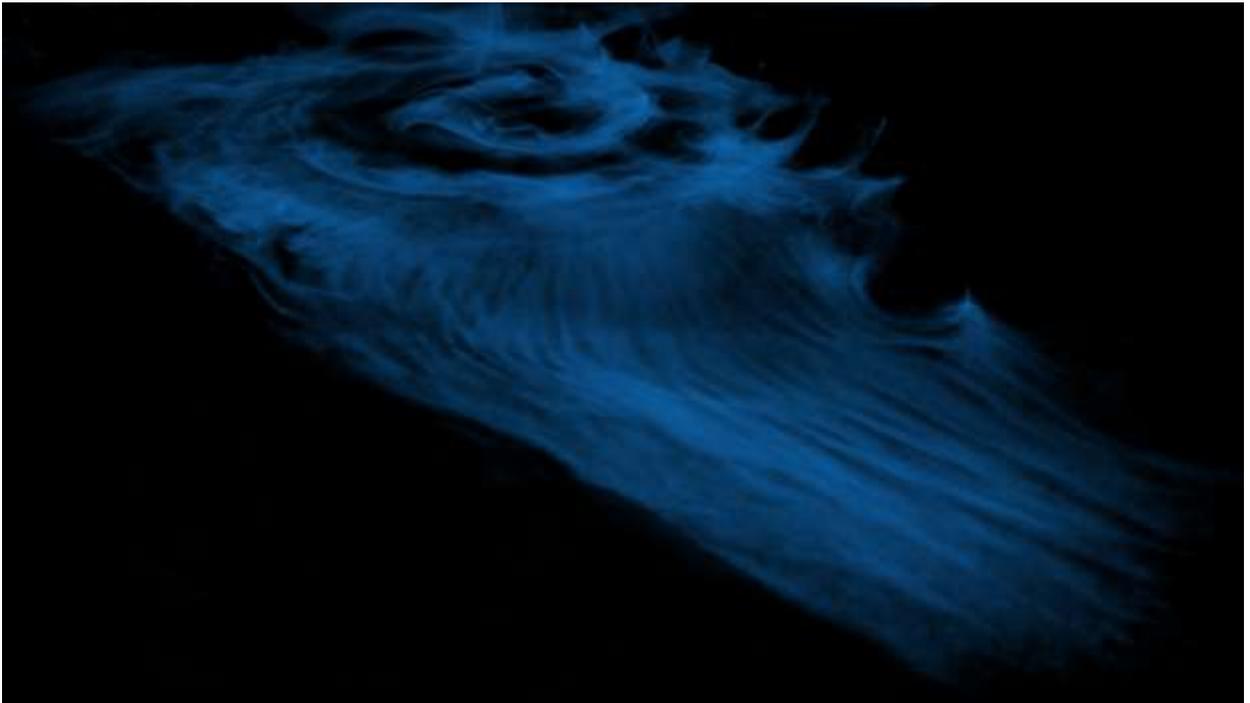


Brittany Feddersen

MCEN 4151: Flow Visualization

Group Image II



This image was submitted for the second group project. The group (consisting of Davis Fogerty, Jaewon Kim, Lisa Logel, Justin Simmons, and myself) used an ultrasonic nebulizer to create vapor in the air, which shows the movement of the air.

The image shows the movement of air on the flat surface. The predominant swirl in the vapor was likely caused by someone walking by before the image was taken. The air near the outside of the swirl moves quickly due to the person walking by. But the air further inward is less disturbed, the viscosity of the air causes the quickly moving air to wrap around the slower moving air resulting in the swirl. The general motion of the air from someone walking by also causes the streams that go to the bottom right of the image. In general, the motion of the vapor was relatively slow. Due to the dry climate in Boulder, the vapor also evaporated rapidly.

The ultrasonic nebulizer used by the group came in the form of a fountain thanks to Mrs. Fogerty seen at the top of the original image (Figure 1). An ultrasonic nebulizer generates high-frequency electronic waves under the water level. These vibrations perturb the water enough to produce a vapor mist. This mist is light enough that it is carried by the air and can be used to visualize the movement of air. However, the mist is more dense than the air, so in general, it will sink; also, it is important to note that the vapor will be carried to the outside of the flow in corners as a direct effect of the greater density. For the image, simple ambient lighting in the Durning Lab at the University of Colorado was used. Additionally the flash on the camera was on. The nebulizer was placed on a black tri-fold board.

The diameter of the swirl was approximately 8 inches about 1.5 feet from the lens of the camera. The image was taken using a Canon PowerShot SX20 IS. The f-stop was $f/2.8$, with an ISO-250, and an exposure time of $1/60$ seconds. The distracting elements, such as the nebulizer, were cropped out. Then, using Gimp 2, the contrast of the image was drastically increased to get the background completely black and bring out the detail in the vapor. The seam in the tri-fold board was also digitally removed; in the final image, it is not perfect, but it is dramatically less distracting. The image was also artificially colored blue. This color distortion does not detract from the physics of the flow, but it does make the image more interesting and adds some character.

Overall, I think this image turned out well. I think the color adds a lot and makes it different from the images of the rest of the group. I also think the swirl looks really good, and there is some really good depth due to the high contrast. I would have liked to have gotten the seam out more, but with the flow right over it, that was very difficult. In taking this image, it was difficult to focus on the vapor rather than the background or the droplets on the tri-fold board. Another difficulty we encountered was getting the background to be a clean black. As seen in the original, the tri-fold board reflected a lot of light, which detracted from the contrast of the white on black. The flash added to the reflection of light, but without the flash there was a lot of motion blur due to the longer exposure time.



Figure 1: Original Image

Source:

"Nebulizer." *Wikipedia*. 06 Apr. 2011. <http://en.wikipedia.org/wiki/Nebulizer>