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MCEN 4151

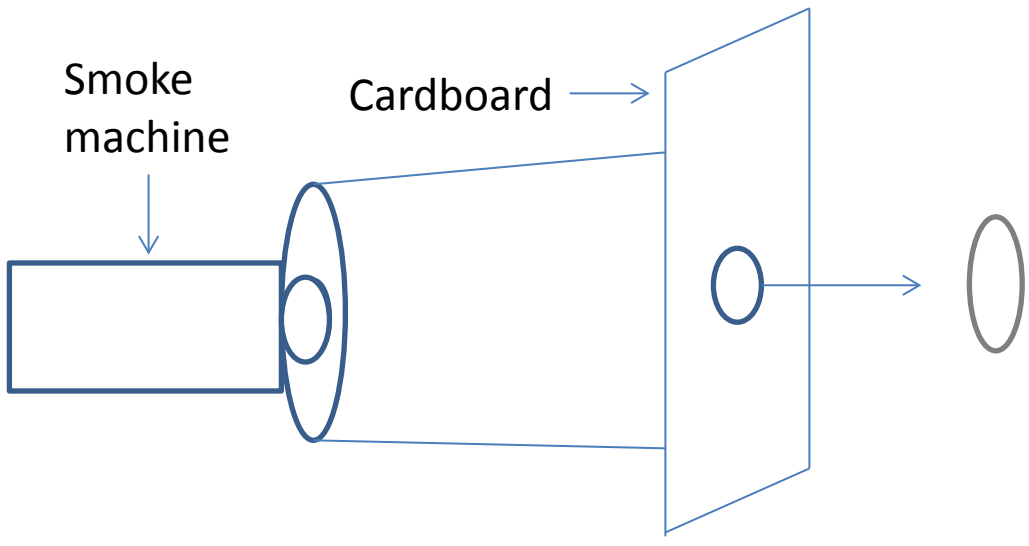
Team Assignment 1

Professor Hertzberg

Smoke Vortex Rings

The purpose of this photo was to utilize the members of our team to create yet another elegant image of flow visualization. Our group was interested in the physics and visual affects behind smoke rings. The group consists of me along with Lotem Sella, Paul Sweazey, Wayne Russell, and Kelsey Spurr. Smoke is a very fun and interesting fluid because it allows you to see unique flows of air that is around us every day. If the smoke rings are created correctly, one can see the vortex the smoke creates as it travels through the air.

The apparatus that we used to create the smoke rings was a very simple set up, and it worked very effectively. A bucket was purchased and a hole was cut out of the bottom where the smoke would enter from a fog machine. On the top of the bucket, various pieces of cardboard were used to cover the opening. The pieces of cardboard had different sizes of holes for different smoke rings. We tested different sizes to see which would create the best rings.



This experiment was done indoors with a black background, which was necessary in order to photograph the rings with clarity. The hole size I found to be most effective was a 1.5 inches in diameter. It is crucial to make sure the bucket fills with enough fog before trying to create the rings. The rings were made simply squeezing the bucket, which would force smoke out through the hole on the top. The shot was taken outside with flash with minimal lighting from the sun setting.

Vorticity is created only at the boundary layer. Shear forces in the air cause the outside of the ring to move slower relative the global movement of the ring. The outer layer gets sort of recycled at the back of the ring in the wake of the inner part of the ring, which is moving faster. This results in a counter clockwise vortex rotation if we follow the right hand rule. As the ring moves through the air, each part of the ring tries to get the other parts to rotate around it. This is how we can see vortexes rotating while moving through the air. This is called self-induction. In my final image, it almost looks like 2 rings are intertwined in each other, which happened as one ring ran into a previous one. The final image can be seen below:

This photo was taken using a Sony Cyber Shot DSC HX30v, which is a small but powerful point and shoot camera. The field of view for this photo is about 6 inches. The ring was about 20 inches from the lens when the photo was taken. The original photo can be seen below:

As you can see, a lot of post processing went into this to come up with the final photo. First, I changed the image to black and white because I thought it would make the rings really pop. I also increased the contrast for the same reason. After increasing the contrast I thought it would look even better with a completely black background so I did some editing to do so. With an entirely black and white image, I was still unhappy with the look of the rings so I decided to edit out some of the residual smoke on the inside and outside of the ring.

This image reveals some interesting physics about air flow and vortex rings. In the final image I like the sharpness and clarity of the image, although some parts may be over exposed. The actual vortexes are hard to see in this image but it is still visually pleasing. I would like to find or make another device that could better depict the vortexes themselves. Overall, I am very satisfied with this assignment.