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Team First Report
MCEN 4151 – Flow Visualization
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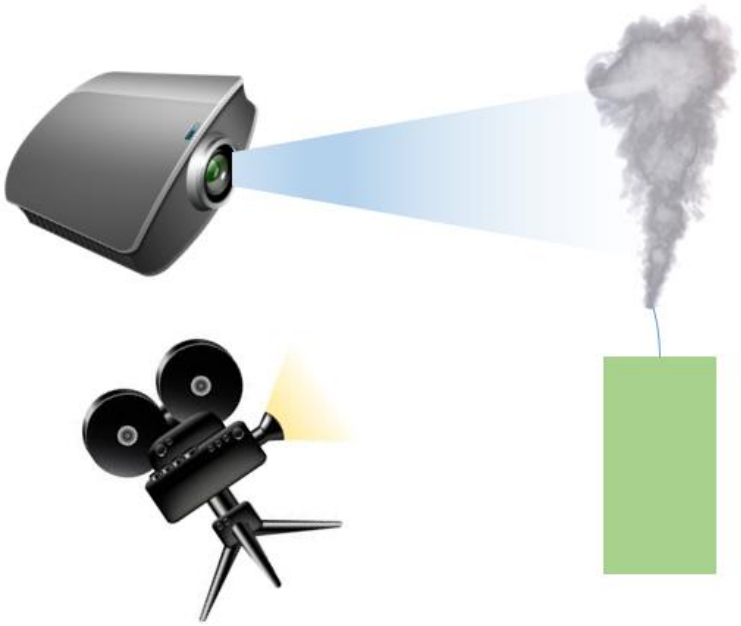
Projection Through Candle Smoke

This image is a still from a series of video clips. The experiment was to observe the colors and images shown through a cloud of candle smoke when a projector is shown through it. I worked with my team, including Luke Collier, Zachary Marshall, Philip Nystrom, and Yousef Shashtari, to set up the experiment and record several video clips. The Flow Visualization website shows the video I put together to show fast-moving clips of the smoke to some up-beat music. I chose the music to contrast most of my team, as they used slow-motion and slower music to capture the smoke, but I liked the faster pace in my video.

The diagram below shows the setup of the projector and candle, made using Microsoft PowerPoint. The team used a projector from a classroom and a few cameras to capture different angles. A candle was lit and then extinguished, creating a plume of rising smoke. Images were sent through the projector in the hope that we would see actual figures, but this was not as successful as we had hoped. We used different projections, and decided that the best videos came from colorful videos that simply changed between bright colors very frequently. This way we were able to see the smoke change colors very quickly and vibrantly.



Setup of Projector Experiment

The science behind the experiment is based on buoyancy effects and turbulent flow. At the source of the smoke is the candle wick, which has burning embers that produce smoke. Initially, the smoke is slow-moving and relatively laminar. As the less-dense smoke rises in the air, the smoke accelerates and becomes turbulent flow. At the top of the plume the smoke is very turbulent which causes it to spread and disperse.

The other phenomenon of interest is the opacity of the smoke. The reason we are able to see the projector image on the smoke is due to the transparency. Since the smoke is relatively opaque it does not let all of the projector light through, which is why we can see colorful images displayed on the plume. If the smoke was more transparent, we would likely struggle to see any images at all, and if the smoke was more opaque it would resemble a projector screen with the image relatively clear on the plume. Since some of the light can pass through the smoke, we need a dark room to clearly see the colors on the smoke.

The FOV on this image is approximately 4 feet by 5 feet. I chose this region to focus on the specific plume here and reduce the background distractions. The flow was about 5 feet from the camera, which used a standard 18-55mm lens. I used a Pentax K100 for the shot shown above. In the end, I used LightWorks for the video compiling and color. The image is fairly close to what

the flow appears as in real life. The video software was available for free and I learned to use it in a few hours to put together the music with the clips.

I think this video turned out very good. I was surprised at how long it took to learn the editing software that I had used, but I now have that skill if I need to use it in the future. I think the video displays the physics pretty well and looks very pleasant. If I could improve this video, I might consider changing the music and timing of the transitions, as it did seem to skip abruptly or drag on depending on the clip and music timing.