University of Colorado
Boulder

MCEN 4151: Flow Visualization

2021 Fall Image/Video First Report

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1. Introduction

One day as I was fulling my smoothie blender up with blueberries, a banana, and orange juice, I thought about the flow inside the bender while it was on. It's amazing how such common, average everyday activities use fluids concepts. From day to day it is easy to not give as much attention to but if you stop and think about it, it is easy to be mind-blown by how complex the phenomenon is. This sparked the idea of using my bender to performing my flow visualization assignment 1. The purpose of this video was to understand the centrifugal forces of fluids better while exploring the concept of flow visualization and how to best represent a phenomenon through a lens. This report will thoroughly go though how to reconstruct this experiment, classify, and explain the flow phenomenon.

2. Experimental Set-up and Materials

To be able to capture pictures and videos of the centrifugal forces of water phenomenon a physical experiment had to be conducted. Using our personal computes for image editing were able to create the experiment using the following materials:

Materials Used In Experiment		
Material	Description	Quantity
Canon EOS Rebel T5 DSLR	18.0 Megapixel Digital single-lens reflex camera	1
Tripod	Portable support, elevate and stabilization device	1
White back drop	Flat white surface that can be used as a background	1
Lighting	Lighting such that the experiment is well visible	2
Fruit blender	Used to induce the centrifugal force	1
Iodine concentrate	Used for the deep brown color	5-10 drops
Water	The fluid were capturing	2-8 cups

Table 1:This table shows the quantity of each component required to run the blender experiment.

To set this experiment up you must first set find a level and sturdy surface to place the blender machine. An example of the fruit blender that I used can be seen in Fig.1. Then pour water into the blender canister and connect the canister to the blender. Once it is all connected plug the blender into the wall socket and turn the blender on. After you have taken all your footage, turn the blender off, and disconnect the plug from the wall socket. Pour a few drips of the iodine concentrate into the water and repeat the above sets. Be careful when you are unscrewing the lid from the canister because pressure could have built up inside. Shown in Fig.2 is a schematic of the experimental set up during the experiment.

Figure 1: nutribullet -Fruit blender[1]

3. Flow Phenomenon

Centrifugal force is a phenomena observed from a point on a rotating object. It is an apparent force that does not exist when observed from a stationary point not located on the moving object (such as a stationary system or an inertial system in uniform motion). In fluid dynamics, when considering a vortex or a fluid with any rotating motion, we often consider the motion of a particle riding on the fluid (a rotating system). The particle experiences an apparent force, the centrifugal force, pushing it to the outside of the rotation. When the centripetal force is in equilibrium with this, the fluid will continue its circular motion (vortex). In a rotating fluid, the outboard side becomes a high-pressure region, while the inboard side becomes a low-pressure region. The difference in these pressures generates an inward force acting on fluid particles; this becomes the centripetal force. When observing from an object moving in a circular motion shown in Fig.2 on the right, an apparent force(centrifugal force) seems to be acting on the object. This can be seen in the video when the fluids are high on the outside(high pressure) and low on the inside (low pressure), thus the vortex is formed.

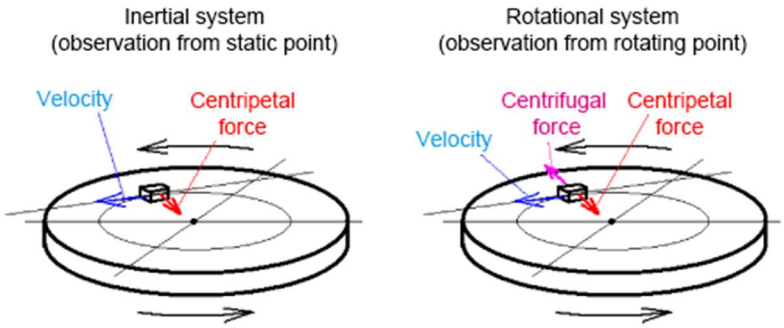

Figure 2:Centripetal force Vs. Centrifugal force

4. Photographic Technique

To begin you must first set up the "scene", I did this by placing my empty blender machine on the table and my camera across from it. Using the cameras view finder eyepiece and constantly adjusting the tripod until the camera could stand still with the middle of the blender in the middle of the frame. Then I taped while canvas paper on the wall behind the blender and checked to make sure no parts of the wall could be seen in the cameras frame. I then placed two lamps on either side the camera and covered them with white towels. An example is shown in Fig.2.

Figure 3: Experimental Setup

One thing that I attempted to accomplish was the mysterious effect. I wanted to place just the blender canister in the camera frame and nothing above or below so that the viewer would be confused and unsure how I was able to capture the flow. An example is shown in Fig.2 The only edits I made to the footage form the camera was a small contrast adjustment.

Other than that I wanted the raw look to the footage to show the viewer it wasn't magic and was just mysterious. Represented in Fig.4 is two pictures of what was shown in my cameras view finder eyepiece during the experiment.

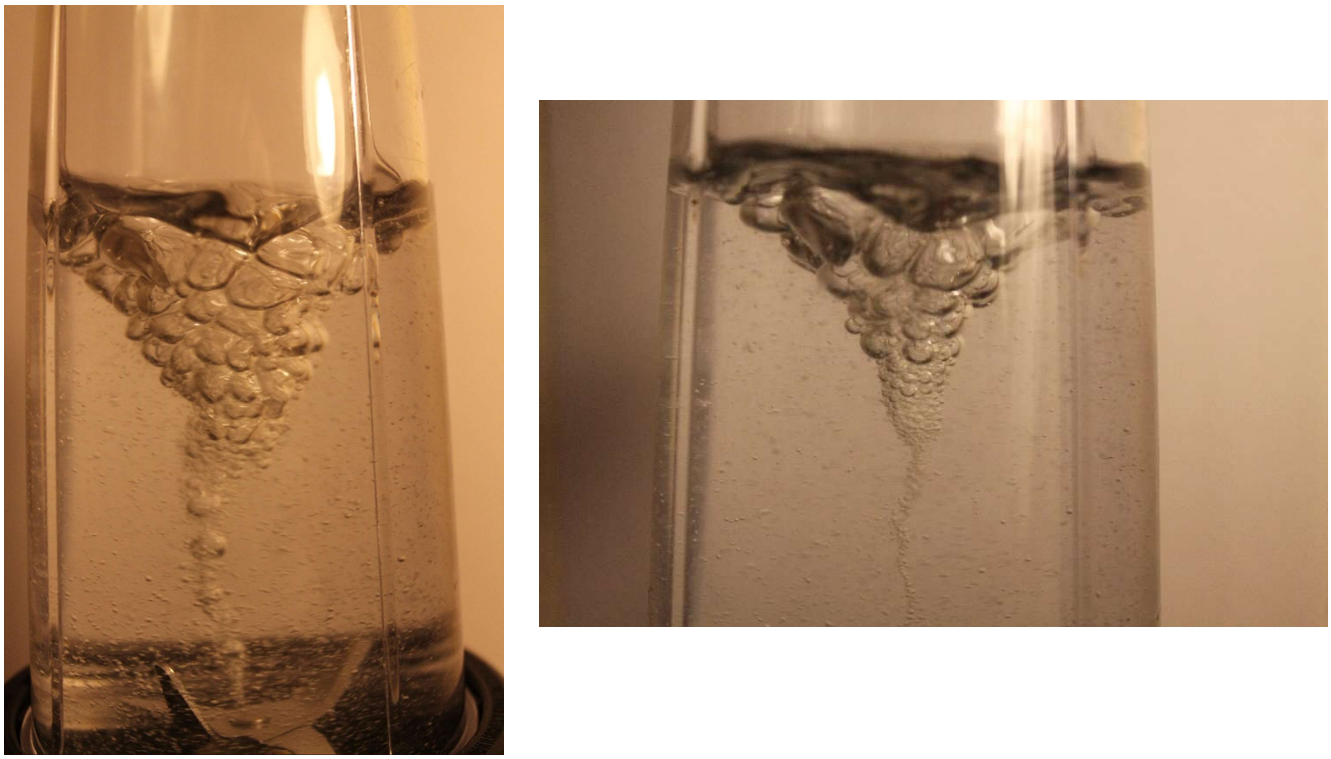

Figure 4: Pictures of phenomenon, contrast enhancement on the right photo

5. Conclusion

After performing the experiment, recording the experiment, re-performing, re-recording; it was amazing how often I saw this similar phenomenon all around me in every day life. If I was to go about doing this experiment again, there are a few things I would have changed. First being, the focus in the video was a bit off and If I focused on an object and then right before I was really to film moved that object out of the frame, that would made the film more crisp. Secondly, the lighting did not turn out the way I wanted it to, I would have gone to a light room on campus and conducted the same experiment. Other than that I was really cool to learn more about centrifugal forces as well as flow photography and visualization effects.

6. References

[1] "Nutribullet Pro Website Exclusive Colors pro 900 Edition Blenders." *Nutribullet*, https://www.nutribullet.com/shop/blenders/nutribullet-pro-exclusive/?gclid=Cj0KCQjwkbuKBhDRARIsAALysV5-2Jw3eM5F5ivzQ0tsDSEwQPyCXKBGUtC5cfVGTNuKs6zsn_wHRCcaAjcsEALw_wcB.

[2] "Centrifugal Force." *JSME Fluids Engineering Division*, https://www.jsme-fed.org/experiment-e/2012_4/005.html.

[3] "Centrifugal Force." *Encyclopædia Britannica*, Encyclopædia Britannica, Inc., https://www.britannica.com/science/centrifugal-force.

[4] "Centrifugal Force." *Encyclopædia Britannica*, Encyclopædia Britannica, Inc., https://www.britannica.com/science/centrifugal-force.