Fall 2018 Team Second Impulse to Chalk

MCEN: 4151

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With aid from:
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INTRODUCTION

This is the second image produced by our team and for this one we decided to visualize the flow of large particles experiencing some sort of external force. We used chalk and many different forms of force on the small chalk particles. We tried fans, blowing and dropping things next to them, to create large air forces on the particles. We also found that using the paper used for shooting, we could create an upward force by pulling the paper taught. This is what I found produced the most exciting image of visualizing the particles undergoing an external impulse function. This image was produced by Garrett Gerchar with aid from Ivan Komodore and Justin Truong.

SETUP, PROCEDURE, AND FLOW

We began by placing a table next to a wall and placing black paper on the surface of the table and a black sheet on the wall the table was next to. After taping the sheet down and ensuring it wouldn't fall, we set up a large LED light board about 5 feet high and pointing downwards to the chalk sitting on the table which was about 3 feet tall. After the lighting and chalk were placed on the black paper on the table, we compressed the paper to create a concave surface in the center of the paper containing the chalk as seen in Figure 1.

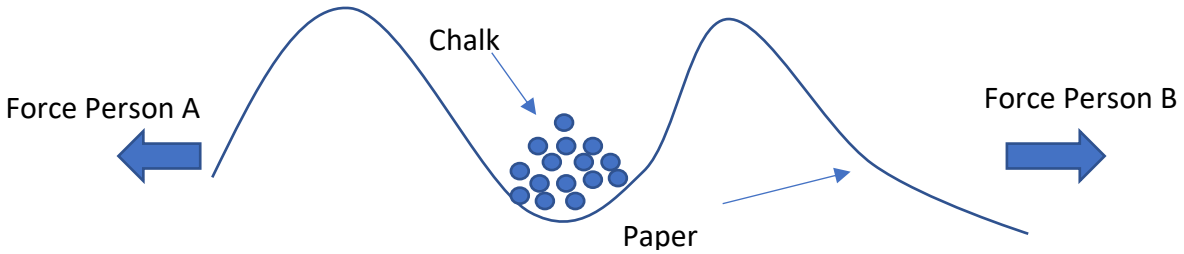

Figure 1: Experimental setup

After getting the setup as seen in Figure 1, person A (Garrett Gerchar) and person B (Justin Truong) pulled the paper taught giving the chalk an impulse force upward. This then allowed Person C (Ivan Komodore) to hold the camera 6 inches away from the flow and capture the image of the flow seen in Figure 2.

Figure 2: Original Image of Flow

This flow is visualizing small particles experiencing an impulse force from paper being tightened. This gives the particles an initial velocity that is then opposed by gravity as they travel upwards. Due to irregularities in the chalk surface among other unaccountable interactions the particles act along a projectile motion path. However, the chalk particles can interact with the each other as they travel through the air. The particles also undergo drag while traveling through the air causing their motion to be drastically stunted compared to similar motion experienced in a vacuum [1]. Overall the flow can be modeled as projectile motion with air drag.

VISUALIZATION AND LIGHTING TECHNIQUE

This experiment was easy to execute using typical construction paper, climbing chalk and a high-powered LED panel. Using a wall with a black sheet that diffuses the light causing the camera to pick up the light reflected off the particles only as they travel through the air. The light was setup, 5 feet high, 3 feet back from the table, and angled downwards toward the chalk on the table.

PHOTOGRAPHING TECHNIQUE

The setup for capturing this fluid flow is relatively simple. The field of view of this image is about 1 foot as seen in Figure 3. The camera is about 1-2 ft from the chalk as it flows through the air level with the table. The focal length is 30mm. We used an exposure time of 1/2000 and an ISO of 6400. This Photo was taken on a SONY ILCE-6300. The photo went through post processing to produce Figure 4. It was cropped to center the chalk flow on the canvas, editing curves to bring out the contrast of the white chalk on the black background, and inverting the colors of the photo.

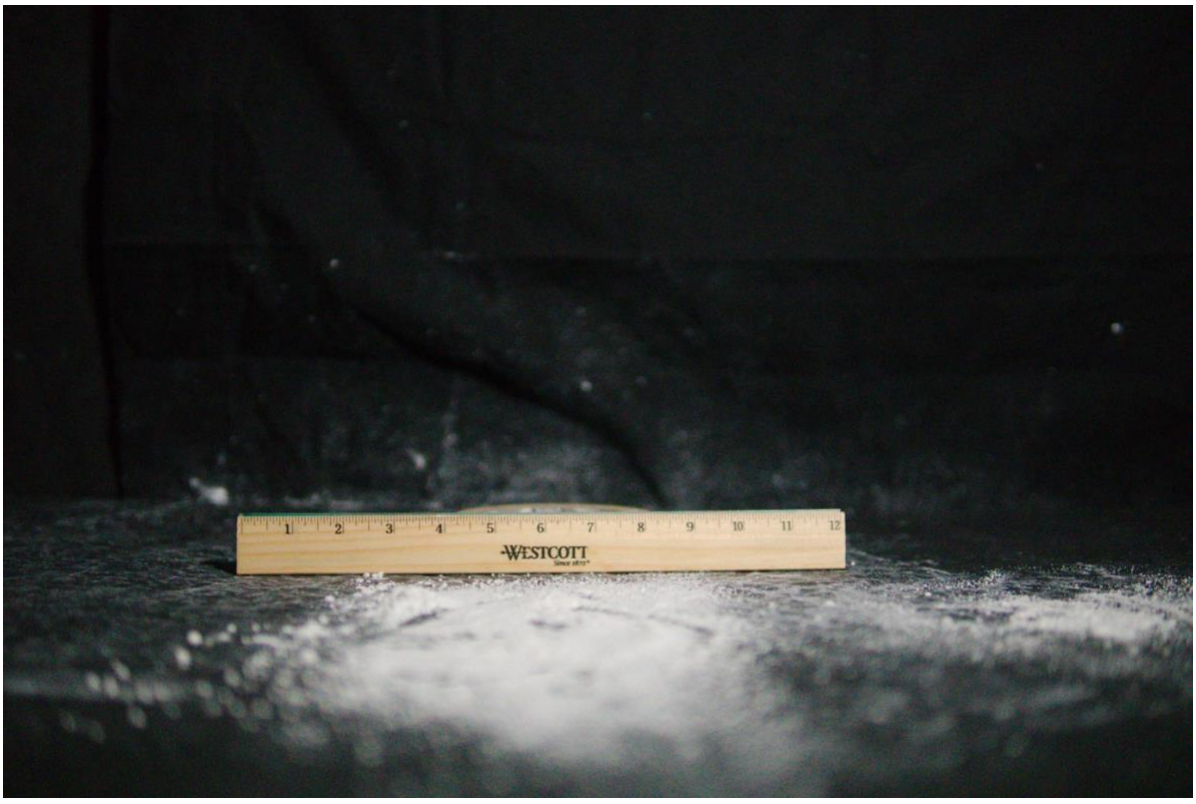

Figure 3: Field of View of the Image Taken

IMAGE AND CONCLSUION

Figure 4 shows how particles exhibit projectile motion when experiencing an impulse function from beneath the pile. I like the randomness exhibited in the photo and how inverting the colors makes the closer particles really defined. Wish the image had a little more definition of the entire flow and not the closer particles even if it visually is very pleasing. The image blur is minimal and finding the velocity of the particles would be a very valuable piece of information. Lastly creating a more controlled experiment could aid in finding the flow phenomenon occurring in this situation.

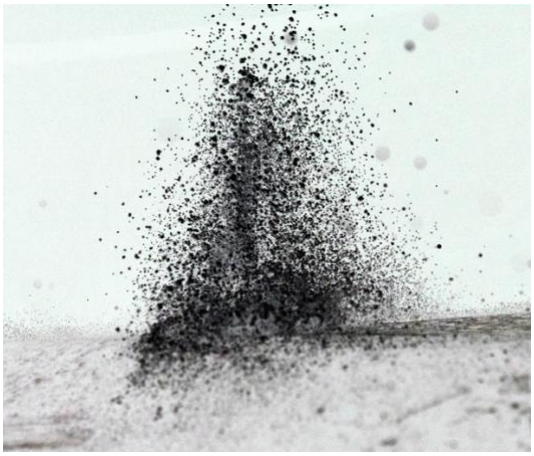
Figure 4: Final Production Image

REFRENCES

"Projectiles with air resistance" Accessed 11/11/18.
http://dynref.engr.illinois.edu/afp.html