Team Third

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Model: Chelsie Kowalski

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1 Introduction

For the third team photo our team did a couple of different things. What I focused on was fabric in air. This image was taken as Lost Gulch Overlook in Boulder on November 30^{th}. It was a very cloudy and cold day, and this gave a beautiful foggy background for the image.

2 Experimental Setup

There was very little to this experimental set up. It was simply a shot taken in the wind on top of a mountain. We tried many different locations on this rock to get the composition perfect, and make sure the image worked well. The set up ended up being a lot of guess and check.

3 Fluid Physics

The motion of the fabric can be modeled in a few different ways. One of them is a mass spring model that accounts for wind and air resistance on different nodes in the fabric. This method uses a summation to create a force balance in the fabric itself.[1] This model is used for computer simulation of cloth, but also does a great job in explaining how it reacts to a fluid flow, in this case the air surrounding it. The equation (1) is below describes the cloths reaction.

$$F_{net}(v) = Mg + F_{wind} + F_{air\ resistance} - \sum k(x_{current} - x_{rest}) = Ma \tag{1}$$

In this case, you can see that every part of the dress gets a force applied to it from the wind, air resistance, and gravity. It is the combination of all these forces that cause the fabric itself to accelerate, and move, in any direction. Since all parts of the fabric that are being affected by the air are connected to each other, you can model them as small masses attached by springs. The springs are based on the spring constant of a piece of fabric. Using this method it's easier to see how each part of the fabric is being affected by drag and force from the air, yet also by the other pieces of fabric in the dress. This creates beautiful patterns in the dress as it moves in the wind, as it is not very stable in most parts and moves in unpredictable ways.

4 Visualization Techniques

The visualization technique used in the image was a light fabric dress. The model wore this dress and flung it up slightly in the light wind. By doing this she created a beautiful flow through the layer of fabric that was was captured by the camera. When taking this image with a short shutter speed, you can see lots of detail in the dress itself.

5 Photography Techniques

I was using an Olympus OM-D mirror-less camera with a 14-42mm zoom lens. The camera was in full manual mode so I could make sure the settings matched what I was trying to capture. In this image I wanted as much light on the subject as possible given the fogginess of the day, so I used the flash included in the camera. This limited the shutter speed to have a maximum rate of $1/250^{th}$ of a second. This gave barely enough time resolution for the flow of the dress to be visible, but it still came out pretty well. I chose and aperture of F/5 to get enough depth of field without sacrificing light. From these two settings I started at a low ISO and moved up until the images had the right amount of light. The ISO in the final image was 800. When I took this photo it was done using no zoom. The focal distance was 14mm and it was taken from about 6 ft away. This was to ensure the flash would light up the subject as much as possible. The last thing that had to be set was focus. This was set manually as auto focus did not function well in the foggy environment. After quite a few shots, the image you see turned out exactly as I was hoping. The photograph had a decent amount of post processing. Saturation, exposure, and contrast were all slightly altered. It was cropped down to focus specifically on the dress and the models left arm was photo shopped completely out to alter the composition.

Figure 1: Unedited Image

6 Comments

This was a great photo to take, and I loved how it turned out. Photoshoots are always fun, but the added physics involved made it even better.

References

[1] Fisher, Matthew. “Matt’s Webcorner.” *Matt’s Webcorner - Cloth*, Stanford University, 2014, graphics.stanford.edu/ mdfisher/cloth.html.