Team 3

Flow Visualization

MCEN 4151

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Fall 2015

Introduction

The purpose of this assignment was to use all the knowledge we've gained throughout this course and capture one final image with our assigned teams. Up to this point we have been working with our teams on two past assignments and this one in particular was to encourage us to achieve most difficult fluid phenomena.

Methodology

The inspiration behind my image actually came from a picture I stumbled upon while I was browsing the web. The images shown in figure 1 were the images that caught my attention.

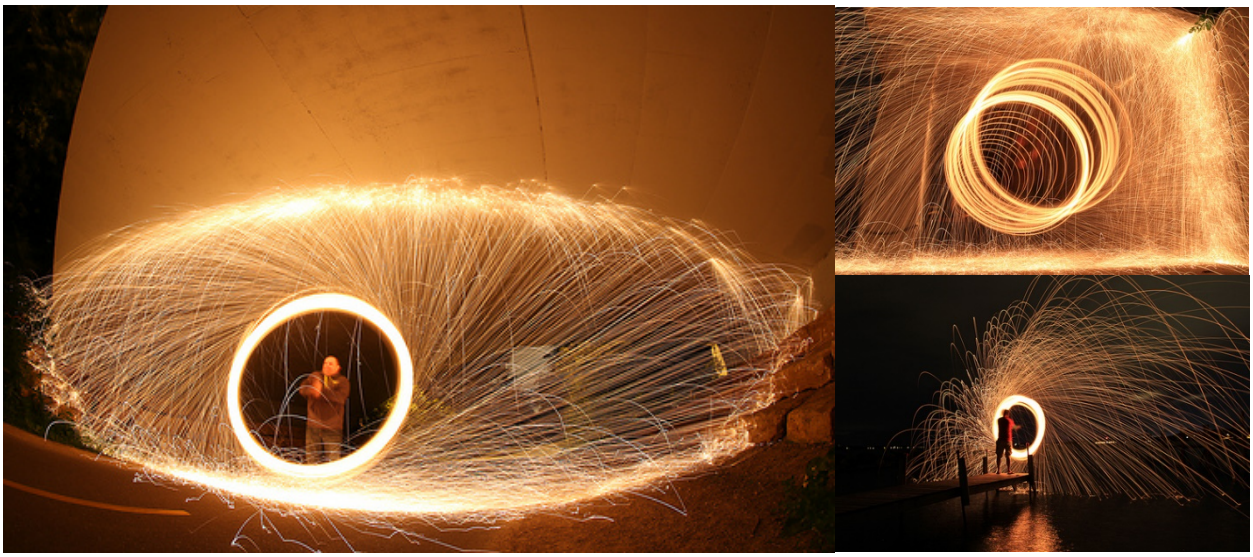

Figure 1: Inspirational images by Mike Mikkelson [1]

This image led me to photographer Mike Mikkelson's website, where he had many different long exposures of this phenomena which I found out involved steel wool. Luckily his website also included detailed descriptions of exactly what I needed to recreate this types of images. According to him, he coined these images as the "Fire Wool Vortex [1]." There were only a handful of materials that were needed to put together the apparatus to create this effect. Below are the materials I used for my image.

Materials:

- Steel Wool Grade #000 or finer (burns better)
- Metal whisk (with a hole in the handle)
- Approximately 6ft of twine
- One 9v battery
- Fire extinguisher
- Tripod for camera

To construct the apparatus I first began by tying (tight knot) one end of the twine to the end of the metal whisk through the hole in the handle. Once I had a tight knot, I took a pouch of steel wool, roughly the size of my fist, and began to pull it apart to allow more air to flow within its center. Then I pushed the deformed pouch of steel wool into the cage part of the whisk by simply prying an opening. The end result looked very similar to the image on the right. This was the tool I used to spin the steel wool away from my body.

Gathering the remainder of the materials, I went outside on the night of Nov. 29th in the middle of an open green belt in Centennial, CO. I set up the tripod approximately 20 feet away from the location of the shot and positioned the camera to face the least amount of light. After a few test shots to hone the camera settings, I was really for the first trial run. I set a 10 sec delay on the camera to allow me to run into position and ready the steel wool.

With the 9-volt battery and apparatus in hand, I started the delay and ran into position. While holding the whisk, I touched the two terminals of the 9-volt battery directly to the steel wool. This completed the circuit between the two terminals and immediately caused a small portion of the steel wool to smolder. Then with the opposite end of the string in hand, I let the whisk dangle freely and began to spin the whisk on my side. While all this was happening I could hear the shutter open so I also began to slowly turn my body while spinning the steel wool. This was actually unplanned and a spur of the moment idea which created a very nice sphere-like effect.

Analysis

One of the first things I noticed was that as I spun the whisk, the additional air flow around it would fuel the combustion reaction. The additional oxygen caused the steel wool to light up bright orange and also caused the reaction to happen much faster. This also became my first issue. I first had the camera set up for a 30 second exposure. I found out that the speed that I spun the steel wool at controlled how long the reaction lasted. As I was limited with the amount of steel wool I could fit into the whisk, I found that a 20 second exposure while slowly spinning the whisk (approx. one revolution per second) yielded the best results.

I also noticed that the centripetal forces that acting on the wool as well as the combustion reaction caused small burning fragments of steel wool to fly way from the whisk. This is how the fountain effect was created. Small fragments would fly off with each spin of the whisk and leave a nice trail of light for the camera to capture. These small burning fragments of wool, which looked like sparks above a fire, would then land safely in the snow where they would quickly extinguish.

Disclaimer

Working with fire can be very dangerous and it is always important to use safety protection. I recommend safety precautions such as eye protection, gloves, and a fire extinguisher. I performed

my shots in a very snowy area of a green belt, I DO NOT recommend recreating this shot in open areas in a very dry climate. I am not responsible for your actions.

Technique

I was lucky enough to borrow a friends digital Canon EOS 5D Mark III and tripod for this shot. I shot in manual mode with an ISO of 100, F-stop of f/20, a shutter speed of 20 sec., and a focal length of 24mm. I actually felt there was no need to crop the image (5760 x 3840). The camera was about 20 feet away from me and I was approximately 15 feet away from the next closest tree.

I actually did a heavy amount of post processing to this image. First I used the stamp tool to get rid of the distracting light on the left side of the image. Next I used the lasso tool in combination with the magic wand tool to select the areas of the snow with distracting footprints which I then used the patch tool select areas of clean snow. This got rid of the majority of footprints leading to the camera. I also used a soft brush on blend mode at about 13% opacity make the sparks and spark lines stand out. This also added a nice effect in the areas where the sparks hit the snow. I then added a series of layers where I manipulated the curves to make the dark colors appear more blue. This made the orange feel warmer. Lastly I added a final sharpening layer to give the image the final pop.

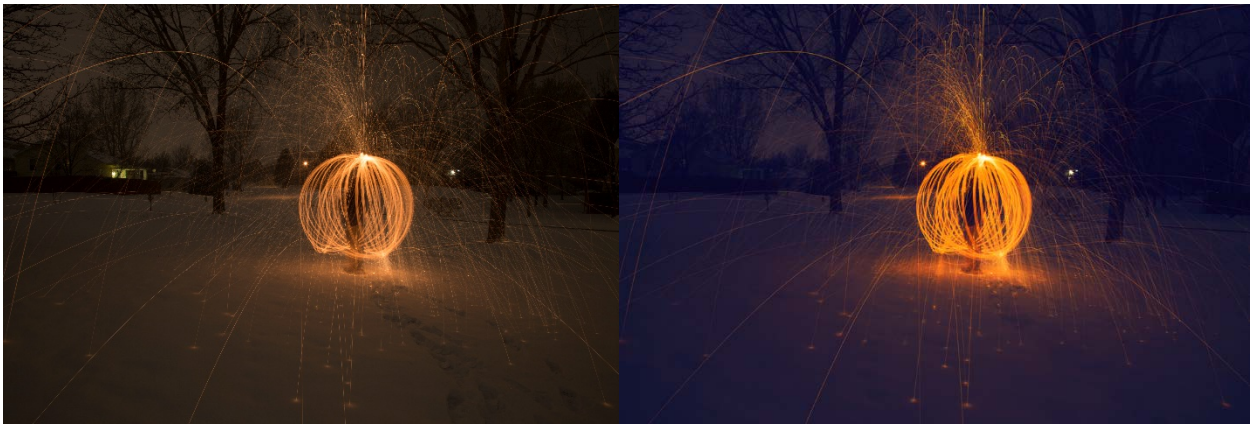

Figure 2: Image before post-processing (left) and after (right)

Conclusion

I am extremely pleased with the way this image turned out. In my opinion this is my best images of the semester. The only thing I dislike about the image is how you can see me within the sphere. I wish I had tried something like this earlier in the semester therefore I could have explored the technique behind long exposure in much more detail. If I were to do this shot again I would try using a larger whisk so I could fit more steel wool within it. This would cause the reaction to last much longer and maybe would have allowed me to rotate slower which could then hide myself from the image.

References

[1] Fire Wool Vortex: “How did you get that shot?” Web. 12/11/15 http://blog.m2-hoto.com/2012/11/fire-wool-vortex-how-did-you-get-that.html

Acknowledgements

Kylie Fitts