Flow Visualization William Murray
Team Project #1 03/11/2009

For this project our team decided to capture plasma being emitted from a Tesla Coil. The lines in the image are plasma filaments resulting from electrical discharge from the coil. High energy discharges are characterized by thicker lines. This is the phenomena our group is capturing in our visualization projects. I worked along side: Larissa Rhodes, Mark Reusser and Brian Hancz.

The apparatus used to create the plasma is a Tesla coil. The basic circuit is shown in Figure 1:

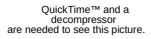

Figure 1: Basic Tesla Coil Circuit[1]

The basic function of the Tesla coil is to produce a very high potential at the top of the Torus. This potential can be in the millions of volts. However the Tesla coil we used is in the ~10,000 volt range. Since there is such a large potential which is discharged into the air as electrical charge, heat, light, and sound. The primary coil creates a magnetic field that transfers energy to the secondary coil. This energy is then transferred into the surrounding air through plasma filaments. In this image alone ~60 filaments were created in a half a second. Thicker discharges indicate higher energy filaments[1].

To get a clear visualization of what was going on, we used a grounding rod to produce concentrated sparks. The only lighting came from the plasma itself, however there is some background light we were not able to eliminate.

The camera used to take this image is a Canon Rebel XSi with a 55-250mm f/4-5.6 IS lens. The camera is digital with an APS sized sensor. Manual exposure was used to control exposure length and f-stop, which was a half a second. The f-stop was set to 4, the focal length was 55 mm, and ISO set at 100. The original image width/height are the

[1] http://en.wikipedia.org/wiki/Tesla_coil

same at 4772 pixels by 2848 pixels, and the final image is 2016 pixels by 724 pixels. The field of view is approximately 17 inches wide and 8 inches in height. The camera was positioned approximately 6 ft from the Tesla coil, and facing perpendicular to the plasma flow. The image has been cropped and inverted. The inversion makes the plasma filaments easier to see with the green on white background.

This image demonstrates the eradicate behavior of a plasma filament through air to ground. Also we notice the difference between the lower and higher energy discharges by the thickness of the filament. It is interesting to see the paths the filaments take through the air. They don't necessarily follow the quickest physical route, but the path of least resistance. It makes me wonder what is going on with the bunching on the right side of the image. Many of the filaments bunch up there before preceding to the grounding rod. It would be interesting to explore this further using different methods to ground the plasma and see what happens. I saw some interesting examples online of placing a piece of quartz by the torus, ejecting neon gas through the center of the torus, and more.