Gregory Collins- 11/23/2018

With the Help of Duncan Lowery, Bradley Busek, and Brent Eckles

FILM 4200-001 - Group Third Visualization Report

The idea for this image came from a picture I took for a mad scientist lab set up. When I set up the Jacobs ladder, I thought ‘hey that would be an awesome Flow Visualization photo opportunity.’ I brought my team out to TinkerMill who had a Jacobs Ladder or called High Voltage Traveling Arc. We wanted to show the effect of an arc rising if we could explain why it happens.

To set up we placed the Jacobs Ladder on in front of a black ground. Camera were mounted on tripods. Lighting was either ambient room lighting or no lighting. This allowed for the camera to only pick up light form the arc. The arc was generated by a neon transformer that turned the 120 AC to about 6 KV. The wires are bent in a way to allow for easy spark ignition with a minimum spark gap. The spark is the is the effect when voltage meets or exceed the breakdown voltage of the gas at a given distance. The result is an arc that forms between the two electrodes which then reduces the resistance between the to electrodes and allows current to flow until the voltage is no longer great enough to hold the arc. For the Jacobs Ladder arc break is due to the increase resistance from the distance increase between the electrode’s as the arc climbs. The reason the arc climbs is primarily driven by convection. The arc is really a plasma that can reach temperatures of several thousand degrees. This cause the air around the arc to rise pulling the ionized gas (plasma) with it. The visible light of the arc is caused by the electrons exciting the atoms in the gas causing fluorescing effect when the electrons of the atoms drop back down to a lower energy state emitting light.

To take this photo I used a mirrorless Panasonic G85 at 16MP. To get the effect of a frozen plasma flame I took a long exposure of half a second. The aperture was as wide as the lens would allow at 6.3. The lighting was only that of the arc itself. The focus was very difficult do to the wire vibrating do to the force acting on it by the repeated arc ignition. So the photo is poorly time and spatially resolved. If I would do this photo again, I would control the environment better. The arc was consistently being blown or stretched by the moving air of the force air heater in the room. I would also try to contain the electrode to reduce the vibration to allow for better focus. And finally, I would like a better lens that could capture more light to better be able to take a faster picture.

References

“Electric Arc.” *Wikipedia*, Wikimedia Foundation, 28 Oct. 2018, en.wikipedia.org/wiki/Electric\_arc.

“Spark Gap.” *Wikipedia*, Wikimedia Foundation, 24 Nov. 2018, en.wikipedia.org/wiki/Spark\_gap.