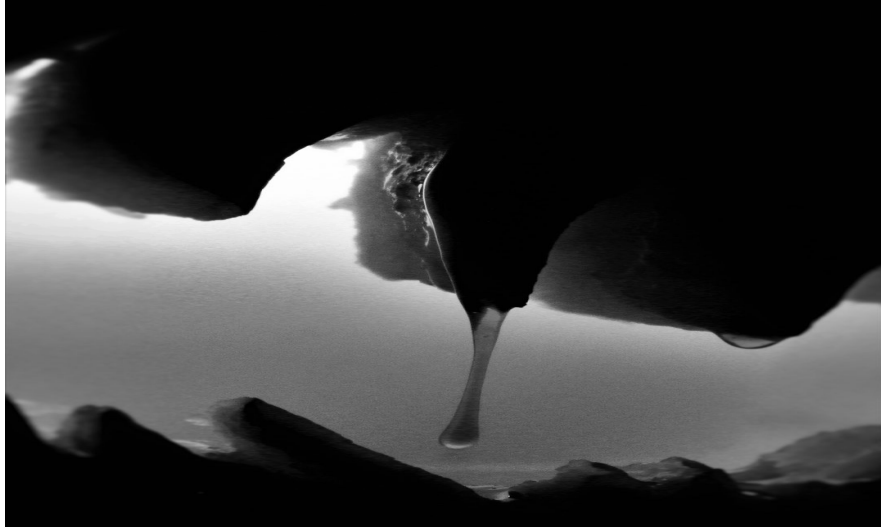


Theo Petrides
Team First Report
Flow Visualization

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Viscous fake blood flow and dry ice give the carved pumpkin a 'spooky' feel

Introduction:

Our initial idea began with creating something involving fire. We had originally set out to do something involving boric acid or creating colorful flames using these flame packets which have a variety of different sulfates in them that produce different colors when ignited. However, we decided to go a different route given the circumstance that it would have been too dangerous at the time of the photography. We weren't well equipped to plan out something involving flames.

In the spirit of Halloween, we decided to do something simple. It involved using a fake blood which was carefully put onto the pointed teeth of a carved pumpkin. The overall viscosity of the blood would extend long enough to take an image that would provide a "spooky" feel, but also demonstrate basic fluid flow. Furthermore, we used dry ice purchased from a local King Soopers for an additional fluid flow effect to our setup.

Procedure:

The procedure was rather simple. The list below shows the items required to give us our final photos for each team member.

- Camera Equipment: DSLR/tripod
- Pumpkin and various cutting utensils for carving

- Fake blood and dry ice used for flow visualization
- Gloves to handle dry ice and Q-tips to apply fake blood
- Flashing LED lights and scented candle to light up inside pumpkin
- Various house lighting fixtures for proper uplighting up pumpkin
- Newspapers to avoid mess

The overall process was fairly simple overall. First, the pumpkin had to be carved out. We searched online for different stencils until we had found one that seemed ideal.

Later, we placed newspapers on the kitchen table and began carving the stencil and removed all the seeds and other unnecessary pumpkin guts. We had particularly liked the teeth on our pumpkin and thought it would be a great idea to apply the fake blood to the teeth and capture images as it fell slowly.

Once all the carving was done, we placed water at the base inside the pumpkin and carefully placed a candle inside which was then later lit to illuminate the pumpkin from the inside. The water provided a area to allow the dry ice to sublimate. We had originally tried colorful flashing LED which would make the sublimation of the dry ice look a lot better, but we were satisfied with those photos, and instead decided to use the continuous lighting of the candle.

Once we placed our candle inside the pumpkin we lit it carefully ensuring we didn't burn any of the surrounding areas inside the pumpkin. We felt it would be better to have the carved out lid of the pumpkin remain away from the lit candle as it could have caused unnecessary smoke in the house, and surprisingly provided a better overall camera shoot.

The dry ice was carefully put into the front of the pumpkin where it's mouth was and the dry ice sublimated quickly in the base where there was water. This provided a 'oozing effect from the mouth was. Next, we applied the fake blood with the Q-tip to each of the teeth. We had multiple trials to ensure we would get different yet unique photos for each of our team members. The Q-tips allowed us to uniquely paint each tooth of the carved pumpkin and gave us enough time to allow the viscous flow to creating hanging drop.

Analysis:

Camera Technique:

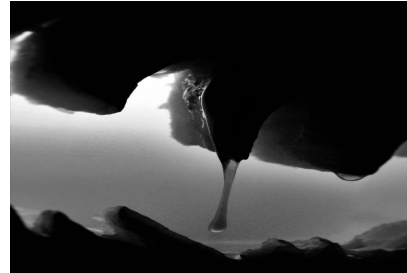
The camera was placed roughly $1\frac{1}{2}ft$ from our test carved pumpkin. The following camera settings are listed below for the raw image. Furthermore, the final edited image was done in Gimp to achieve a final effect that was most desirable. A grey filter was added to give the pumpkin a more eery feel and was cropped to give a better overall visualization of the viscous

blood flow. Seen on the next page are the differences between the unedited original image and final edited image.

Unedited Image:



Edited Image:



Camera Settings and post processing:

Device: Canon EOS Rebel T5

ISO: 3200

Shot: 1/60 sec. f/5.6 55mm

Test subject distance: $1\frac{1}{2}ft$

Post Processing:

The final edited image was post-processed using Gimp, the photo was cropped around the pointed teeth area to focus more on the fluid flow. Furthermore, a filter was added to give a eery grey feel to the pumpkin.

Viscosity Equations:

The Fake Blood which is mostly a mixture of (insert ingredients here), is formed from a slender drop approximation and can be equated by the following equation and diagram below:

$$A(x, t) = 2 \int f(x, z, t) dz$$

FIG 2: As referred to as the slender drop area approximation which determines the area of the droplet as a function of the integration from the derivation of specific boundary conditions of the Navier-Stokes Equation.

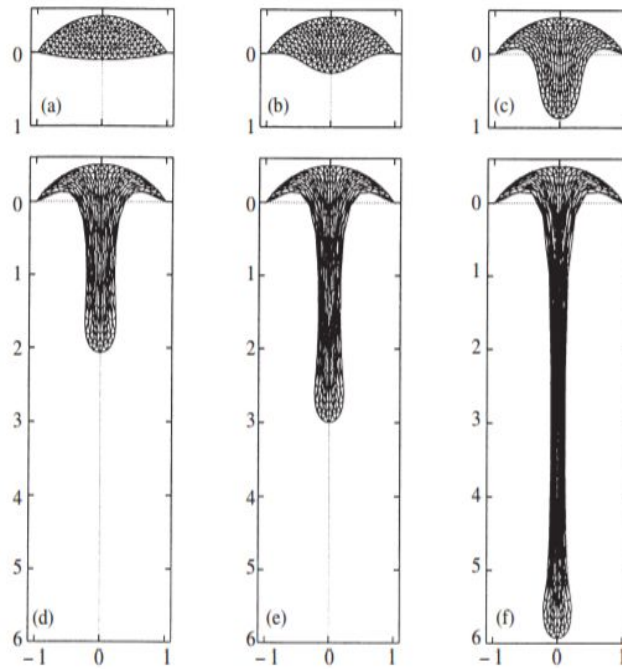


FIG 3: Shows the droplet as the time increases so does the length and furthermore the area.

The longer the time spent dropping due to gravity the longer the fluid drop will be in this equation it ignores the breaking of the fingering of the fluid droplet because as time goes to infinity the length of the droplet increases. However, under this circumstance the we can ignore the fact that it won't break, in case of the pumpkin we only care about the axisymmetric occurrence that is happening with the fake blood flow.

Sublimation:

Dry Ice/Compressed CO₂ gas

The process of sublimating gas requires that the solid CO₂ gas, or dry ice in this instance is in contact with water which is warmer and thus creates a endothermic reaction resulting in the sublimation of the dry ice and emitting a gas as a result. This gas is seen as a white smokey effect that is used in a lot of Halloween applications.

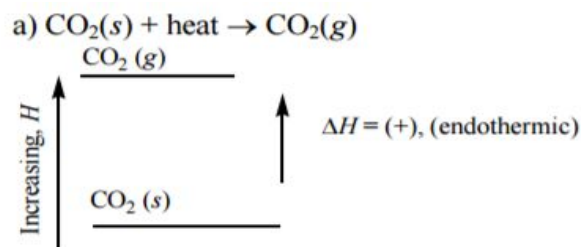


FIG 1: Demonstrates the process of sublimating dry ice

Conclusion:

The overall image, portrays something that the team had really enjoyed. It focused on the viscous blood flow of the pumpkin which gave it a more overall spooky effect in the spirit of Halloween. Furthermore, the dry ice added kept the candle and other various background elements from being distracting, lastly, the candle added a warm feel to the photo and kept the focus more towards the viscous blood flow.

If I were to change anything about this photo for the future, it would be interesting to experiment in Gimp with post processing in order to get red viscous blood flow from the tooth instead of grey to highlight the blood flow a lot better. I am really happy with the way the resolution of the photo turned out and would consider doing something like this again, but on a much bigger scale!

References:

- Introduction and Procedure written by Theo Petrides
- Ebooks-Gratuits.Me > Balanced Equation Combustion
- Stokes, Y. M. "Extensional Fall of a Very Viscous Fluid Drop." *The Quarterly Journal of Mechanics and Applied Mathematics* 53.4 (2000): 565-82. Web. 1 Nov. 2016.