

Team Third: Rubens' Tube

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MCEN 4151: Flow Visualization

December 14th, 2019



Introduction:

My team and I wanted to see the visualization of sound waves through the use of a rubens tube. A Rubens' tube is a metal tube with many small holes evenly drilled into the tube. A flammable gas is pumped into the tube and is ignited to make a constant flame. A sound wave can then be visualized by having a source of sound near one end of the tube. The final image was captured with the assistance of Faisal Alsumairi, Robert Drevno, Matthew Knickerbocker, and Abishek Kumar. Drevno provided the bluetooth speaker and Kumar provided the Rubens' tube setup.

Fluid Physics:

Sound waves can be idealized as sinusoidal in form. Although we cannot physically see them, we can visualize them through the use of a Rubens' tube. When a sound wave comes out from a source, it travels as a sinusoidal wave. If we propagate this wave through a more physical medium compared to air, we can better see the wave. If a sound source is placed at one end of the tube, it will flow through the flames and the flames will alter its height and size to the sound wave.

Experimental Setup:

An eight foot Rubens' tube that was previously purchased from another group was used. The tube was then filled with propane from a propane tank. One end of the tube was sealed with a rubber latex glove to ensure that the propane properly filled the tube. After waiting approximately 5 seconds for the propane to fill the tube, a lighter was used to ignite the fuel. The rate at which the propane was exhausted from the tank was controlled by a valve on the tank. This valve allowed us to get the proper height and size of the flames coming out of the tube. A bluetooth speaker was then used in combination with a sound wave app. This speaker was placed an inch away from the end with the latex on it. A 125 Hz sinusoidal sound wave was then output from the speaker, causing the flames coming out of the pipe to distort.

Photography Techniques:

The camera used to capture the final image was a digital Canon PowerShot SX530HS. A medium shutter speed of 1/2000 was used, with an aperture of f8.0 and an ISO of 3200. This produced an image that was 640x480 pixels. The captured image was when the lens was approximately 4" from the flames. Post-processing of the image was done in GIMP. The image was cropped to include less of the insignificant background. The contrast and brightness were turned up. The chroma was also changed to enhance the image and give it a red tint to the final image.



Figure 2. Original raw image

Conclusion:

The final image shows sound waves propagating through flames. I like how the sound wave can visibly be seen. I dislike how reflective the tube was and I was not able to edit that out. I believe that the main intent of finding out more about sound waves was realized especially through the use of a Rubens' tube to better visualize the effects. In the future, I would like to repeat this experiment with different environmental surroundings due to the wind at the time of capturing the image.

References:

Rubens' Tube:

https://en.wikipedia.org/wiki/Rubens%27_tube