Group Report #3

MCEN 4151

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This report discusses the third and final image that was to be taken for the MCEN 4151 - Flow visualization class. The intent of the image was to capture the interaction of waves across the surface of a fluid. The phenomenon that was attempted to be observed was the interaction of waves including constructive and destructive interference. As it was raining the day that the experiment was to be set up, I simply observed a puddle that droplets of water were falling into instead of creating an elaborate apparatus.

The flow apparatus that was used was already completely in place when the photo was taken. The apparatus consisted of simply an overhang on the engineering center and a puddle below it. The camera was located below the overhang as to not get wet in the rain. The setup that was used can be seen in Figure 1.

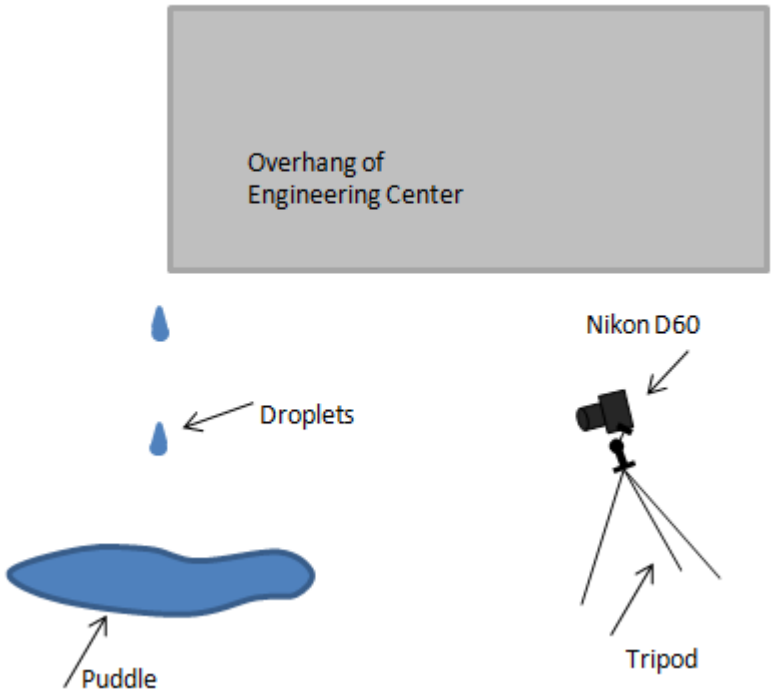

Figure 1. Flow Apparatus

The droplets fell from the overhang of the engineering center, roughly 10 feet above the puddle. When the droplet impacted the puddle it disturbed the water causing a wave to propagate outward in a ring. The amplitude of the waves is estimated to be 0.5 cm. The wavelength, λ, is estimated to be 1 cm for the majority of the rings. Knowing this, the wavenumber, k, can be estimated by dividing 2π by the wavelength. This yields a wavenumber of 628.31. The angular frequency of the waves, ω, is estimated to be 0.25 seconds. Given this information an estimate of the velocity that the waves are propagating outward at can be found. This is determined by dividing the angular frequency by the wave number. Conducting this calculation yields a velocity of 4 centimeters per second.

The visualization technique that was used was simply to watch the droplets hit the puddle. The glare from the sky was utilized so that contrast was added aiding the visualization of the rings. The lighting that was

used was solely the natural light that was provided by the sky, this was sufficient to capture the desired image.

The field of view for the final image is about 2 feet wide by 1 foot tall. This field of view allowed for the ability to capture the details in the waves as well as being able to see the full rings. Since I did not want the camera to get wet during the photographing of this image, I stood below the overhang of the engineering center. Thus, I was roughly 6 feet from the puddle. For this reason a focal length of 120mm was used to zoom in tight while remaining a good distance from the puddle. The type of camera that was used was a Nikon D60 and the original capture output a 3900 x 2613 pixel photo. After cropping, the photo became 2800 x 1964 pixels. To get the exposure that was captured an aperture of f/5 was used. This allowed a deeper depth of field while still being able to use a fast shutter speed to minimize motion blur in the waves. The shutter speed that was used was 1/250 of a second and the ISO was set to 100 to minimize noise in the image. After the photo was taken, Photoshop was used to simply crop, rotate, and increase the contrast in the image. In Figure 2 a before and after image can be seen.

Figure 2. Before (Left) and After (Right) Images

The final image reveals the natural flow physics that are around us every day; displaying wave propagation and construction and destruction of these waves. The physics within this image are displayed well and easily understood. I feel that I fulfilled my intent and incorporated nature into the desired outcome. Aspects I would like to improve would be to see more drastic interactions of the waves and possibly achieve better lighting on the image. This idea could be developed further by isolating the apparatus and experimenting with various heights to drop the water from as well as pool depth to see the effect it has on the waves.