

Flow Captured By High Speed Camera

Project three by group 5 focuses on the dynamics of flow phenomena as seen and captured by a high speed camera. Our intent was to observe the intricacies of flow motion by slowing down the video frame rate. By exploring images that the human eye would not normally detect we can reveal the inner workings of these rapid flow dynamics.

Numerous flow apparatus were used when creating this video. I will refer to segments of the video as clips 1-5. For clip one a simple setup was used that consisted of a background 80watt bulb in a fixture with the foreground comprised of a squishy tentacle ball (which was found at RiteAid). This clip depicts the violent shaking of the squishy tentacle ball in extreme slow motion. This clip reveals an interesting phenomena of motion that is similar to swaying algae in water. Side to side force and gravitational forces pull the tentacles side to side with the tips of the tentacles following the motion of the ball in a slightly delayed fashion. Clip 2 consisted of a splatter ball, made of thin sticky rubber and water which was obtained in Beijing China, hitting a black LCD computer screen. The splatter ball is propelled by human force and gravity to impact the LCD screen thus flattening and spreading the splatter ball fairly evenly across the screen. After dispersal the splattered rubber slowly returns it's original ball like form as the water regroups. Clip 3 used a fish tank filled with water as the main apparatus. The tank of water was intricately lit and then milk was dumped into it at a rapid pace. The high speed video reveals turbulent jets and later cloud like formations.¹ The clip was rotated 180degrees which revealed bubbles sinking toward the bottom of the screen. This clip explores dilution of fluids, gravitational forces of the milk entering the water and sheer forces. Clip 4 was simply a dog shaking its head. This clip was mainly taken for the title sequence, but the motion of the dogs shaking lips does reveal a phenomena similar to Clip 1. Gravity and force cause the observed

motion of the dogs lips. Clip 5 consists of a champagne glass filled with water with a black background. A syringe was filled with water and held 3 feet above the champagne glass. The syringe produced a drop of water which fell 3 feet into the glass of water producing a Worthington jet upon impact.²

Numerous visualization techniques were used with various substances. Clip one used the squishy tentacle ball filled with air obtained at RiteAid. Clip 2 contains a LCD monitor and a splatter ball filled with water which was obtained at the Olympic Center in Beijing China. Clip 3 contains a fish tank filled with cold water and warm 2% milk which is poured in the tank at a rapid pace. Clip 4 contains an English bulldog. Clip 5 contains a champagne glass filled with room temperature water and a syringe also filled with room temperature water. The lighting used in these clips varied from clip to clip. Clip 1 used a single 80 watt light bulb to back light and illuminate the squishy tentacle ball. Clip 2 also used a single 250 watt halogen flood light with a UV filter that was purchased at a hardware store. Clip 3 used 3 lights. Light 1 and 2 were blue and red colored LED lights and light 3 was a 250 watt halogen flood light with a UV filter that was purchased at a hardware store. Clip 4 used a single 80 watt bulb which was located 3 feet above the ground pointed at a slight downward angle. Clip 5 used two small high powered halogen lamps and one blue LED light pointed directly down at the champagne glass. For all of the video the high speed Olympus I – Speed camera was used. Its frame rate varied from 200-400 frames per second with a resolution of 800x599 in avi format.

These clips reveal different dynamics of fluid flow. Clip one emphasizes the similarities between the squishy tentacles and underwater algae which are being pulled to and fro by currents. I like spacy environment this image creates and I believe the physics are clearly shown. Clip 2 explores the dynamics of an impacting liquid filled object that spreads out over a flat surface and then retains its original form. Coincidentally the expansion of the ball and its white color look similar to an egg in a frying pan. I like the visual impact this video has and I believe the physics are clearly shown. Clip 3 is

a great display of turbulent milk jets impacting water. The cloud like visualizations and the falling air bubbles resembled a surreal sunset. I was very happy with this sequence and liked the lighting. Clip 4 was meant to be more amusing for the title credits, but there is a humorous flow phenomena occurring as the dogs lips flap against his face. I like this image for its humor and the physics were shown clearly. Clip 5 contains a nice high speed video of a Worthington jet. Viewing this phenomena with the high speed was an amazing privilege. I like the detail and clarity of the image and the physics are shown quite clearly. This was an amazing process and I hope to be able to use the high speed camera in the future. The images it reveals are striking and extremely interesting to me. I believe I fulfilled my intent, but given more time I would have shot much more footage of differing setups. My only questions would concern how professional special effects masters use these techniques to accomplish visualizations in film. To develop this idea further I would simply need more time with the high speed camera.

Works Cited

Benoit, Cushman-Rosin, Environmental Fluid Mechanics. Thayer School of Engineering, Dartmouth College, Hanover, New Hampshire (2010):153-162

J. M. Cheny, K. Walters, "Rheological influences on the splashing experiment"
Non-Newtonian Fluid Mechanics 86 (1998):185-210.