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Team Project 1 Report
Flume Tank Experiment

This following report corresponds to the first group project. Our group chose to use the flume tank in order to observe a flow phenomenon when injecting food dye in the tank while water flows over a toy car. But ultimately I decided to make a video showing vortices that appear in the drag area of a wooden block in the flume. Our team consisted of three engineers: Stephen Wong, Zach Stein, and Zhou, and a film student: me.

The block was as wide as the tank, about 5 inches tall and 7 inches long and so water went up over the top of the block, but not around the sides or underneath. The wooden block had corners and flat sides except for on side on the top, which was rounded, and contributed to the type of drag that occurred behind the block and thus the vortices that formed. In the diagram, the rounded side of the block is clearly visible. The channel was about 3.5 inches wide, 7 feet long, and 10 inches tall. Water was pumped in from one end of the tank and hit the flat side of the block head on. The water built up and then began to flow up over the top of the block, and then off the rounded side and on to the end of the tank. After the end began filling up the water began to fill up the tank more vertically and continued back towards the front. Eventually there was a steady flow and nothing was getting more or less full. At this point the vortices began to form behind the block. The vortices form because the water in the center of the flow comes over the block faster, hits the bottom of the tank behind the block and then curls over itself towards the side of the tank and continues to get pushed towards the back. These curls of water go up over air and suck air bubbles under water that allow the flow to be visualized. The air bubbles flow in two vortices spinning in opposite directions. If one were to look straight

from the back of the tank towards the block and the front of the tank, they would see that the vortex on the left rotates clockwise and the one of the right rotates counter-clockwise. This of course is because the flow in the middle moves faster and hits the bottom before curling up the sides and over itself.

The flow was essentially self-visualizing in that die or mist or something else had to be added to the experiment in order to observe the phenomenon occurring. The air bubbles being pulled and twisted by the flowing water allowed the phenomenon to be visualized. There were two types of lighting used in order to photograph the scene. First, fluorescent light filled the laboratory setting. Additionally, a clip light was placed directly above the block on top of the tank, facing straight down.

The video was shot with a high speed camera at 240 frames per second and slowed down in final cut with assistance from the optical flow tool. The width of the image is about 16 inches and the height is about 9 inches. The camera was placed about 10 inches from the flow. The camera used was a JVC GC-PX100. The f stop was set to 2.8. The ISO was at 800. The raw clips were created at a resolution of 640 x 360 pixels. The final edit was created using Final Cut Pro X and outputted into a resolution of 960 x 720 pixels.

The video shows the two vortices spinning beautifully in opposite directions in the fluid. They look like two tornadoes side by side. In slow motion, you can observe the way the vortices grow and form against the direction of the flow, quite amazingly. In slow motion it looks like a living, alien liquid metal. Unfortunately the resolution on the camera was quite low once the frame rate was turned up high enough to observe slow motion. I would like to repeat the experiment using a camera that maintains good

resolution at higher frame rates so that the details in the flow phenomenon may be preserved. Nonetheless the video was still successful in capturing some of the beauty.