

Brock Ewing

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Flow Visualization

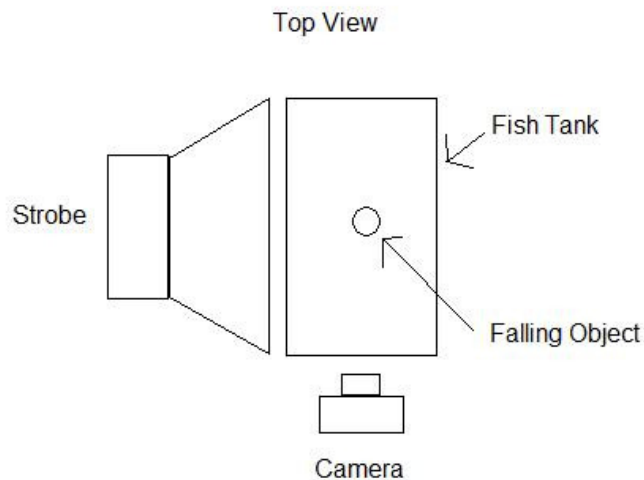
Prof. Hertzberg, Prof. Sweetman

Group Image #3

Pool Ball Falling Through Water

For this image, our group wanted to show the physics of different objects falling through the air into a tank of water. We were very interested in the point of impact as viewed from both above and below. Although this appears to be a very simple interaction and one that is come across quite frequently in everyday life, we felt a closer examination might reveal more to us.

For our set-up, we decided to drop our objects into a fish tank and shoot them from the side. By doing so we were able to view both above the water and below the water at the same time. A schematic of our apparatus is below:



The flow witnessed was very interesting. For my particular photograph, we dropped a pool ball into the tank and shot it after it hit the surface as it was descending in the tank. What was witnessed is many air bubbles being drawn into the tank by the surface of the pool ball. As the pool ball descended into the tank, the air bubble released and rose to the top of the tank in the opposite direction of the movement of the ball. The bubbles coming off the side of the ball appear very turbulent. Estimated velocity at the surface is 8 ft/sec. The estimated Reynolds number for this flow is 266,400. After the bubbles have escaped the pool ball and are floating to the surface on their own, the flow is much more laminar. This transition from turbulent to laminar can be clearly seen in the photograph. It appears to happen about 3 inches above the pool ball.

The visualization technique is fairly simple. We just used water and air with a black background. The biggest difficulty was to get enough light to capture these very fast reactions. We solved this problem by using a high powered strobe. We used a long exposure time in a dark room and used the flash of a White Lightning X800 strobe to capture the image. The difficulty with this was timing the strobe so that it went off when our object was in front of the camera, but with a little practice we made it work.

In my photograph, the field of view is about 6 in by 12 in. The object is about 12 in from the lens. The focal length is 50 mm. It was shot on a Cannon 10D digital camera. The exposure time was 4 seconds with an f-stop of f/8. In Photoshop, I changed the image slightly using the curves feature. This darkened the background and made the white bubbles more visible.

I think the resulting image is a very cool one. It is by far the best image I have submitted this year. The photo is not only interesting from the scientific standpoint but is

also an artistically stunning image. To further explore this phenomenon, I would like to drop many other objects into our tank. One shape that interests me is the one used for the Apollo spacecraft. A spacecrafts entrance into the atmosphere is physically similar to an object falling through air then water. I would like to see the turbulent flow from this.