

Laboratory 4: High Speed Video

To: R&D Team
From: James W. Bales
Date: 12 October 2005
Re: Evaluation of High-Speed Video.
IM4-JWB

I've been asked if we need to purchase a High-Speed Video (HSV) system to expand our motion analysis capability. As these systems cost in the \$20k to \$80k range, I've arranged to have Vision Research loan us their Phantom 5.0 HSV system so that we can evaluate it. I need a head-to-head comparison of the HSV against our standard multi-flash technique, as well as a sense of how the HSV compares to synch and delay.

Assignment

Use the HSV to photograph of a falling object and calculate g from your results. Compare these results to your work with the multiframe system. Next, use the HSV to look at the milkdrop experiment, and compare it to the results you got with synch and delay. Finally, take time to look at something interesting with the HSV. (As usual, discuss your proposal beforehand with the TA/Laboratory Manager, who has final say in what experiments are performed.) Write up your results in a memo. Your memo should:

1. Provide a quantitative assessment of the accuracy of multi-flash and HSV for determining g . Discuss the benefits and drawbacks of each method.
2. Present the HSV image of the milkdrop, and discuss the benefits and drawbacks of HSV vs. Synch and Delay.
3. Present any additional images you obtained.
4. Describe your procedures in sufficient detail that we can reproduce your results.
5. Make a recommendation for our decision to purchase the HSV system.

Laboratory 4 -- HIGH SPEED VIDEO

In this lab you will work with a High Speed Video system. Items in **bold** should be prepared in advance of lab and handed in to your TA.

1. Measure the acceleration of a falling object. Set up the experiment so that you are able to observe the acceleration over a height range of approximately 1 meter. You may use a 28 mm, 50 mm, or 90 mm focal length lens. Assume that the electronic image sensor measures 8.2 mm wide by 8.2 mm high. Pick a lens and set up the camera to maximize your resolution. **What is the magnification? What will be the approximate lens-to-subject distance?**

Think in advance about the characteristics that an object should or should not have to give you good data. **Plan how you will calibrate the image to account for any distortions.**

How long will it take the object to fall? Use the cursor built into the Phantom software to acquire position information as a function of time. Use at least 10 measurements spaced over the course of the fall.

Analyze and plot your data during the lab session so that you are assured of getting reasonable results and can correct any experimental problems as they arise. Include a plot of velocity versus time in your lab report. On the same plot show the relationship between velocity and time you expect on the basis of theory. What value do you find for g ? What are the inaccuracies in the process and how might you improve the experiment? Compare your results with HSV to your results from the multiflash experiment.

As an option you may want to try a second object that you think will be affected by air resistance and see if you can make a reasonable measurement of the drag.

2. Use high-speed video to examine the splash of a milk drop.

In advance of lab plan what lens you will use. You want good magnification, but you do not want to be so close that the splash might actually reach the lens. Let's say as a start that you wish to image an area 2" wide. The electronic image sensor measures 8.2 mm wide by 8.2 mm high. Your Lenses are:

Lens 1: 28 mm focal length; minimum working distance of 0.85 meters.

Lens 2: 50 mm focal length; minimum working distance of 0.45 m.

Lens 3: 90 mm focal length; minimum working distance of 0.40 m.

Lens 3: 200 mm focal length; minimum working distance of 0.71 m.

Which lens should you use, and what are the appropriate object and subject distances?

Burn your files to a CD or DVD. You may download the Cine Viewer player from the subject web page (under "Resources"). Generate printouts to include in your report. Include a sequence of at least five (5) images to characterize the splash sequence.

3. Time permitting, study something that interests you. **Email your proposed experiment to the TA/Laboratory Manager and Dr. Bales 48 hours before you meet for the lab.**