Laboratory 3: Multiflash Photography

To: R&D Team
From: James W. Bales
Date: 30 September 2009
Re: Evaluation of Multiflash Photography.
IM3-JWB

Production has tried to use both stroboscopy and synch and delay to analyze certain problems in our factories, but with little success. I need to know what we can do with a multiflash technique, and if we have the ability to do it in-house.

As a test of the multiflash process, make your best effort to measure *g* (the acceleration due to gravity) using a multiflash photograph of a falling ball.

Also, the board was pleased with our presentation. They would like us to submit a photo for consideration for the cover of the next annual report – we need something that looks great! Create images that might work for the report cover. Examine your images and tell me what quantitative measurements you can make from them, and how they can be improved if they aren't ready for publication.

Assignment
Use the multiflash technique to take a photograph of a falling ball, and use the image to determine *g* - the acceleration due to gravity. Then, take a multiflash photograph of something really neat to be used for the annual report. Try to achieve a photo that might appear in a physics textbook or photography publication (or both). Pick a subject that will allow you to make a quantitative measurement or estimate.

Discuss your proposed subject for the "neat" shot beforehand with the Lab Manager, who has final say in what experiments are performed. Write up your results in a memo, which should:

1. Discuss the types of problems that multiflash can be used for, and any tips or techniques for improving the images.
2. Describe a calibration procedure for our existing equipment, and tell us the correct values for the flash rates of the unit.
3. Present your results for *g*, the photo(s) used to determine the results, and a detailed description of the calculation you conducted.
4. Determine the practical accuracy of this method when used in the factory.
5. Provide the production team with a description of your procedure with sufficient detail to allow them to recreate your result.
6. Describe how you took the image for the annual report, including things like the planning of the image, number of flashes, total event duration, etc. Discuss what quantitative measurements (or estimates) you can make from the image. If the image is not quite ready for publication, discuss what you will do to make it better the next time.

Laboratory 3 -- MULTIFLASH PHOTOGRAPHY

Work to be done before the lab session is marked in **bold.**

Email your proposed experiment to your Lab Assistant *and* Dr. Bales 48 hours before you meet for the lab.

Have your equipment list and work plan written in your notebook when you arrive for lab. For this lab, estimate the time you think it will take your team to complete each task.

1. Use the vacuum photocell to measure the flash rate for all 6 settings of the flash rate. Also measure the BCPS for the "high" and "low" settings at any one flash rate.

2. Take photographs (bracketing apertures) of a ball as it falls over a distance of 1 meter. **Plan in advance the area your picture will cover, the magnification that you will use, and the lens you want to use, with an estimate of where you will need to position the camera. Have these ready to hand in from your notebook when you enter lab.** (We have focal lengths of 28 mm, 50 mm, 90 mm, and 200 mm available.)

3. Create a multiflash image that you would be proud to hang on your wall. The image should *(a)* communicate something, preferably quantitative, about the event it documents and *(b)* have appeal as a thing of beauty.

   This could be something like an experiment or phenomenon out of a physics book or something drawn from your daily experience. It could be a dance, athletic, or martial arts motion. Use your imagination. In planning the photo, think about contrast and other factors that enter into multiflash photography. If a person is going to be in the image, the color of their clothing may be an important factor in the final image quality. For planning purposes, assume the multiflash strobe has an output of 150 to 250 BCPS, and illuminates a 6-foot diameter circle at a distance of 8 feet from the strobe. Don't forget to specify your lens choice.

   Your work plan must include an outline of your procedure for this part of your experiment. Include your best estimate of the time it will take your group to complete each part.

4. Take measurements from your print of the ball falling. In your report, construct a table that includes the position of the ball for each flash of the strobe, and the time of the flash. Compute the average velocity between flashes, and assign that velocity to the mid-point of the time range between flashes. In your report *plot the velocity as a function of time and fit the data to a straight line*. Discuss possible sources of error in your measurement of g.

   NOTE - You cannot assume that either the initial position or the initial velocity of the ball is zero. Also, given the position of the ball at two different times, (x_1, t_1) & (x_2, t_2), you can calculate a velocity. What time do you pair with that velocity, and why?

5. In your report, discuss how you planned and executed the exercise. Include aspects such as planning the composition of the image, selecting number of flashes, estimating the total event duration, etc. Discuss what you parameters can measure (or estimate) from the image. If the image is not quite ready for publication, tell us what you would do to make your images better if you were to do this experiment again.