

4-9-2002

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Recommended Citation

Davidhazy, Andrew, "Introduction to digital stroboscopic motion photography" (2002). Accessed from <http://scholarworks.rit.edu/article/230>

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Introduction to Digital Stroboscopic Motion photography

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Stroboscopic photography for depicting the changing features of subjects in motion is a technique that was enabled and popularized by one of the "fathers" of high speed photography, Harold "Doc" Edgerton. He applied this technique to numerous situations where a still camera, in a single shot, did not capture enough information about a subject in motion and where a motion picture camera record was unsuitable for being reproduced on the printed page.

Photographers use two types of stroboscopes. The first, and most popular, is nothing more than a flashing light source. This is the kind that Doc Edgerton popularized. There is also a cheaper, simpler, mechanical alternative. This consists of nothing more complicated than a rotating disk with a slot cut into it. With every rotation of the disc we are able to glimpse the position of the subject at the time the slot passes in front of our eyes.

In either case, a stroboscope allows us to view a subject on a periodic basis.

Photographers have generally used a flashing light, a stroboscopic light source, to illuminate a moving subject in order to track the subject position over time. This is accomplished by setting up an action situation in front of the camera generally firmly attached to a tripod, opening the shutter of the camera while the subject is moving and the stroboscope flashing and after a while closing the shutter and terminating the exposure.

During the time the shutter is open the moving subject is illuminated by several flashes of light. These leave a superimposed sequence of images of the subject and it is often possible to gain much valuable subject motion evaluation information from such a record or to simply connect with and understand the graceful (or not so graceful) flow of motion of a given subject.

When engaged in stroboscopic photography generally one is interested in photographing relatively long duration events (even though one may only be talking about a second or two!) because it is really pointless to make a stroboscopic record while only recording the subject in only one, two or three positions over time!

For example, to make a record of a golf swing or something similar, we would be looking to make a record over a time period of a second or so. During that time we might want to record our subject in maybe 20 to 100 different positions. This, of course would require a strobe flashing at a frequency of 20 to 100 flashes per second if





we kept the shutter open for a second. An exposure time of 1 second is easy to accomplish with a regular camera but many digital cameras have a limited maximum exposure time.

Recently I attached a mechanical, rotating disk type, stroboscope to a Kodak DC260 camera (which has a maximum exposure time of 4 seconds) and used an exposure time of one second to obtain the photograph shown here. The subject was placed against a large, black, velvet background. The lighting level was adjusted so that the results obtained were of an acceptable quality by making a few preliminary tests and judging the quality of the images on the LCD display screen of the camera. Very convenient and effective!

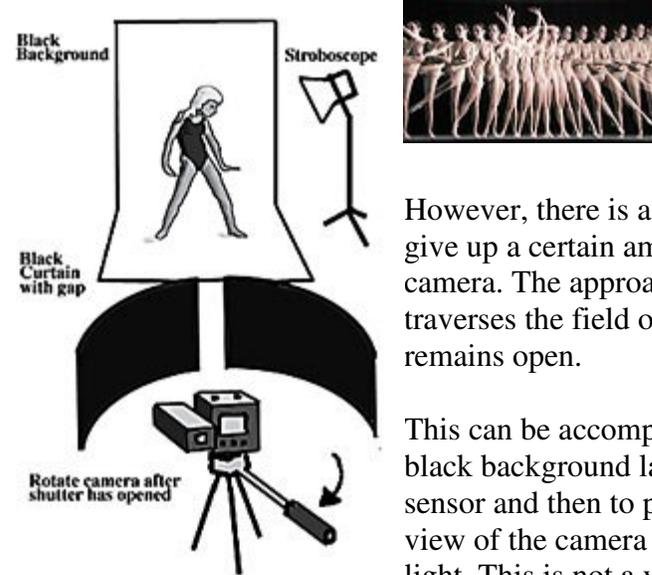
By the way, from this example made over a period of 1 second, the camera recorded about 17 separate images of my amateurish attempt to swing a golf club. From this it can be determined that the mechanical stroboscope's disc was turning at about 17 revolutions per second.

Note that, as with traditional cameras, the background (which should have reproduced very dark since it was black velvet) and those parts of my body that remained essentially in the same position appear significantly overexposed because they reflected light to the same location on the CCD. On the other hand the moving club shaft was exposed in different positions on the CCD with every pass of the stroboscope disc. The moving club, therefore, is exposed only once on any given area on the CCD and reproduces with less exposure than the stationary parts of the scene. One could improve slightly on the tonal range of the image by making the subject wear dark clothing while painting the moving club shaft with a highly reflective or white paint.

If one leaves the shutter for too long the sequential images will start to overlap until a point is reached that they all blend into a uniform "blur" and the specific position of the subject with any given flash discharge can no longer be perceived. If one is interested in motion detail then, in a film-type camera, it is possible to simply put the film in motion while the stroboscopic light flashes (or the mechanical disk rapidly rotates in front of the camera's lens) and the subject performs in front of the camera.

Using a standard 35mm camera the film is simply advanced one frame at a time, with the lens covered, into the take-up chamber without exposing it. Then, setting the camera's shutter to "B" and locking it open during the rewinding process causes the moving film to record the subject's image to ultimately appear displaced "timewise" in the final record. It appears as a sequential set of images showing the progression of motion of the subject over time.

In the digital realm generally there is no possibility for moving the image receptor material as there is in the film realm. The sensor in the digital camera is fixed in place and so while standard, superimposed stroboscopic records can be obtained much the same as with film cameras, the visualization of a subject over time by introducing motion of the sensor is not possible.



However, there is a method to deal with this problem if one is willing to give up a certain amount of resolution in the digital records captured by the camera. The approach is to put the image in motion in such a manner that it traverses the field of view of the camera during the time that the shutter remains open.

This can be accomplished several ways. One unorthodox way is to secure a black background large enough to cover the field seen by the camera's sensor and then to put the subject on a cart and pull them across the field of view of the camera while the subject is illuminated by the flashing strobe light. This is not a very practical way to do things but can be done and has been done by enterprising photographers.

A more practical way to do solve the problem is to realize that the image can be moved across the focal plane by rotating the camera. The subject can remain in approximately the same general location performing some action and the camera is aimed in such a manner that their image appears at one side of the camera's field of view. Then, after the shutter has been opened, the camera is slowly turned in such a manner that the subject's image moves to the other side of the viewfinder before the exposure is terminated.

Clearly then with each flash of light from the stroboscope the subject's image gets recorded on a different location of the the camera's sensor and the motion of the subject can be relatively easily tracked over a significant time period.

A major drawback of this technique is that the field of view of the camera (over time) is now very wide and the flash, stands and studio equipment may reflect some of the light from the stroboscope along with the light from the subject and these times will appear to "bleed through" the subject's image.

To deal with this difficulty I would suggest that the camera be simply surrounded by a curtain of black velvet set up in such a manner that there is a small open slot located between the camera, rotating on a tripod, and the subject. This way the camera will be prevented from seeing and recording anything but that which is available to it through the gap or slot in the curtain. This provides a "ghost" free final record although superimposition of certain parts of the moving subject is still a possibility. This often just adds to the fluidity of the final motion record.

Since one is limited in the size of the camera's sensor the total number of images that one can clearly record depends on how small one is prepared to allow the subject to be within the frame of the camera. The smaller the image size one can tolerate the larger the time over which one can "track" the subject or the number separate images of the subject that can be placed from one side of the frame to the other.

The stroboscope that was used for the photographs shown in this article was a self-built piece of equipment. It had the capability of flashing up to 10 times a second. For image capture the camera that was used was a Nikon CoolPix 990, with the set camera on

manual, the lens set to the widest aperture, the exposure time set to 4 seconds and it was rotated by hand. The illustrations in this article were downloaded from the camera and adjusted in Photoshop 6.0 for final presentation.

By the way, if you want to read about an article that is primarily devoted to traditional, film based, stroboscopic photography but also including the very first digital stroboscopic photos I made with a Kodak DC260 camera (also shown above) plus how to make your own mechanical stoboscope, use of the Colorado 539 and how to improvise a stroboscope with several flashes and a rotating switch, go to [Simplified Stroboscopic System for Motion Pattern photography](#).

If you'd like to communicate with me about this topic simply send me e-mail by clicking [HERE!](#).