

Darklights

Andrew Glassner
Xerox PARC
3333 Coyote Hill Road
Palo Alto, CA 94304
glassner@parc.xerox.com
415/494-4467

Every image creator knows that illumination is an important part of making meaningful images. The play of light on the surfaces of the scene gives it depth and mood, indicates position and character, and reveals both objective visual information and communicates subjective emotional messages.

The interplay of light and surface is a subject which rewards close study. Our purpose in this note is to make better known a tool that is used subconsciously by many painters, and quite explicitly by many graphics designers.

Basically the idea is to use "negative lights". This is something that people have wanted for a long time. In an early Batman comic strip, a villain directed an anti-flashlight onto the hero to place him in a cone of darkness during a crime. In real life our physics does not provide a way to build such an anti-flashlight, but in computer graphics we work with a more general physics that provides the facility naturally.

The idea is quite simple. To create a brightly-illuminated piece of surface, direct onto that surface a light source. This source sends illumination energy to that surface, in addition to any light arriving from other sources.

Suppose now that you wish some piece of surface to appear darker. One approach is to add lights everywhere else in the scene so that the desired surface is relatively darker. A simpler approach is to illuminate the surface with *negative light*. This is easy: simply create a light source whose color is defined by negative numbers. I call such lights *darklights*. Usually there is nothing in a rendering program to prevent you from assigning any numbers you want to the color of a light source. For example, many simple rendering packages specify colors in terms of red, green, and blue components. To cause light to be removed from a surface uniformly, shine a light of intensity $(-0.4, -0.4, -0.4)$ upon it.. If

some rendering system does prevent you from using negative numbers, it's a bug, not a feature: negative sources make syntactic and semantic sense, and should be available in every rendering system.

Consider an example where darklights come in handy. Suppose you have a kitchen scene with a complex lighting arrangement that you set up with considerable time and effort. But from a particular point of view, there's one spot on a countertop that appears too bright - it distracts the eye from where you really want the viewer to look. You could change all the lighting, but that's unsatisfying - the scene is mostly correct, except for this unwelcome bright spot. Simply create a dark spotlight source with negative coefficients and direct it onto the surface. The rendering program will add the light from all the sources that illuminate that spot, which will automatically subtract the light from the darklight, thereby darkening the patch of surface.

Just as with all lights, darklights must be designed and positioned with care to achieve an effect. They are useful for simulating fuzzy shadows, darkening up corners of rooms, and changing the relative brightness of objects without affecting the basic lighting scheme. They are naturally available in virtually all rendering systems. Used with care and sensitivity, darklights can extend your expressive power in the medium of image synthesis.