

Linear Light

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A different way to blend colors.

Computers are supposed to simplify our lives. They often do this by simplifying reality into algorithms they can more easily process. However, sometimes we are better off keeping all the complexity that the real world contains. One area where this comes into play is in how colors of different brightness levels are blended together. In this article, we hope to demystify the subject of “linear light” (sometimes referred to as “linear blending” or “gamma 1.0 compositing”), and show how you can put it to work to achieve more realistic, filmic results.

The Theory

Given a choice, computers prefer to think of “medium gray” as being a 50% mix between black and white. However, our eyes work differently than that; they are far more sensitive to low light levels. For example, a standard gray card used by photographers - which is perceived by our eyes as “medium gray” - reflects just 18% (not 50%) of available light back to the viewer.

This little piece of trivia becomes more interesting when we try to blend a partially transparent footage layer or other object on top of another. If the layer on top was 50% transparent, most software would normally add together 50% of the color value of the pixels from the layer on top to 50% of color values of the layer underneath. But if the software was operating in linear light mode, the result would be weighted much more strongly toward the brighter source colors.

Let’s look at a pair of examples to see what this means in practice:

1) Optical Crossfades

Let’s start with the most basic tasks in editing and motion graphics - crossfading from one clip to another. For illustrative purposes, we’ll use some footage with good contrast between brights and darks: clip TL111 from the Artbeats collection Timelapse Landscapes 1 (Figure 1a), and clip MN102 from the Artbeats collection Musical Instruments (Figure 1b). Figure 1c shows the midway point in a typical computer crossfade from one to the other. Closely study the bright areas in each clip, such as the sunlit horizon in TL111, and the moon or metallic highlights in MN102. Note that both are dulled down toward a medium gray at this point in the fade.

Figure 1: In this first example, we will fade from Artbeats clip TL111 (a) to MN102 (b). A normal computer fade is shown in (c); a linear light or “optical fade” is shown in (d).

Figure 1a



Figure 1b



Figure 1c



Figure 1d



Now study Figure 1d, which is a crossfade using linear light calculations: The brighter areas in both of the source clips pop through more prominently. There's also a bit more mystery to the result, as the dark-suited musician is sliced in two by the bright horizon in the landscape clip - a result more akin to a gradient wipe than a normal fade. This effect is sometimes referred to as an "optical fade" as it more closely resembles the way a fade between two physical pieces of film would look.

2) Motion Blur

Another interesting use of linear blending is when a blurry object is composited on top of another layer. A good example of a blurry object is fast-moving type with a lot of motion blur, as illustrated in Figure 2. The first image shows the result of a normal computer composite: Note how dull the blurrier sections of the type are compared to the less-blurred characters, to the point where they almost disappear! The second image shows the same composite using linear light calculations: The partially transparent blur of the light-colored type is much brighter.

Figure 2



This example shows why visual effects compositors strongly prefer using linear light mode for compositing: It more accurately reflects how objects would look in the real world, resulting in more realistic composites when they need to add new objects into a scene.

Linear Light in After Effects

Linear light gamma 1.0 blending has been an option in high-end compositing programs for awhile, but it has been creeping into other applications as well. For example, Adobe After Effects 7 offered a Linear Blending option in its Project Settings dialog; After Effects CS3 has expanded this to two options: Blend Colors Using 1.0 Gamma, and Linearize Working Space. (Figure 3)

The Blend Colors Using 1.0 Gamma option gives you the basic linear light effect demonstrated above, and is the same as the Linear Blending option in After Effects 7. The Linearize Working Space option is only available if you have Color Management enabled (see the previous Tips & Tricks article we wrote on Color Management in After Effects), and encompasses more functions in the program beyond just compositing - for example, it also changes how effects and 3D lighting work, favoring lighter colors in these areas too.

Zooming Out

Linear light is indeed more realistic, but sometimes unrealistic looks better - so make the decision consciously, instead of blindly flipping a switch. If you are new to linear light compositing, the temptation will be to turn it on part way through a project, think "hmm...that looks different than what I had in mind" and to turn it back off again. (That's if you're thinking ahead. The worst case scenario is to turn it on just before an overnight render, wake up the next morning, and realize your opacities and brightness levels all changed!) Instead, experiment a bit in your spare time, and then make a decision at the very start of a project whether or not you want to work in one of these modes - that way, all the creative decisions you make during the project will be accurately reflected in your final render.

Figure 2: In this second example, we're compositing liberally-blurred text on top of a shot (clip UWD138 from the new Artbeats Ultra Water Drops collection). The first image shows the result of normal blending; the second image show the result of using linear blending - note how the blurred areas hold up much better.

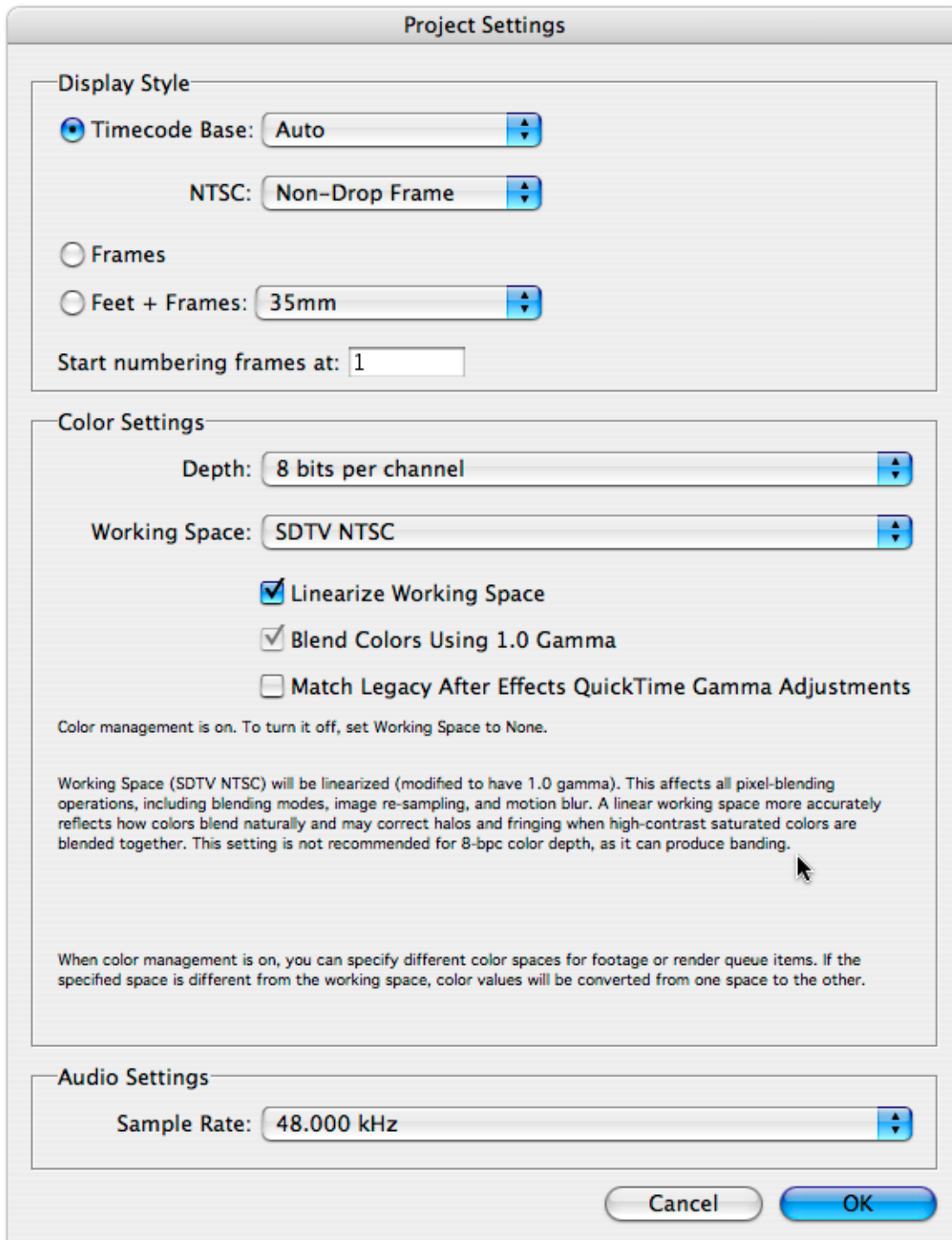


Figure 3: The mode used for compositing is set in the After Effects CS3 Project Settings with the Blend Colors Using 1.0 Gamma and Linearize Working Space options. Read the small type underneath these options when you enable or disable them; it explains what will be going on under the hood.

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