

A Short Course in Color Management

The ability to work with color on desktop computer systems has improved so much in recent years that both professional and nonprofessional artists, photographers, and designers are routinely producing stunning photography prints, online art, and digital prepress art. Increasing numbers of people are drawn to trying these new color tools as low cost color printers and digital cameras draw more users. These users not only want to produce good photographic prints, they want to be able to take good looking images to the web as well.

In the 1980s, users eagerly embraced desktop publishing as it migrated to personal computers, recognizing that they had been given the gift of an extremely powerful tool. Most users quickly discovered that using this new gift without the underlying understanding of type and page layout was much more difficult than they had been led to believe. Over time, an interesting thing happened. The general level of appreciation and understanding of publishing design increased.

Once again we are seeing eager users embracing a useful extension of personal computer technology only to discover that to produce quality photographic prints, web graphics, or color presentations, there are a few things they need to know. A general understanding of color management forms the solid base of most of this knowledge.

If you do not have at least a general understanding of color management—what it is and how it works—then everything that you do to correct and produce accurate color images will be nothing more than the rote following of directions. It will be difficult, if not impossible, for you to think your way through anything but the simplest of color correction and production problems. What I have written here is not meant to be an exhaustive survey of color management on desktop computers, but rather a enough knowledge to build a foundation for repeatably successful image production.

Color management on desktop computers is nothing more than transferring color from one device to another in a predictable and accurate manner. In other words, the colors that show on your monitor should reasonably represent the colors that appear on your printed image. If color is not predictable, then your attempts to produce accurate images become nothing more than laborious trial-and-error sessions that start over for each new image.

Color Management Engines

Color management on personal computers is handled by a color management system (CMS), also known as a color management engine, which is a layer of software that performs the transformation of color information between different devices. Color management is handled on the Macintosh by Apple's ColorSync and under Windows by Image Color Management (ICM).

Color on your computer is represented by numbers, and it is the job of the CMS to simply translate a set of numbers that represents a color on one device into a different set of numbers that represents the same color on another device. Think of it as a translator at an international confer-

ence that takes the word red in the monitor language and translates it into the word red in printer language.

The Basic Tool of Color Management—Profiles

Each color device that you use on your computer has a particular set of colors that it can produce which is known as its gamut. In order for the CMS to understand the color space and gamut used by any given device, that device must have a profile, which characterizes the device's color reproduction capabilities. Although device profiles all perform the same basic function, they can be broken down into three general categories: input profiles that are usually associated with devices such as scanners and digital cameras; display profiles that are usually associated with computer monitors; and output profiles that are generally associated with printers.

Device profiles are only one kind of profile available under color management systems. The other profile most personal computer users should be aware of is a color space profile which describes a device-independent color space. I will address both color space profiles and device-independence later in this tutorial.

Profiles are represented by files on your personal computer and are known as ICC profiles on the Macintosh and ICM profiles in Windows. There is an industry-wide, standard format for these files that was established by the International Color Consortium (ICC). Device vendors typically supply standard sets of profiles for their devices that are installed when you install the software for the device. Alternately, you can use hardware and software to create your own profiles for some devices, or purchase custom profiles from third party vendors.

What Ties Profiles Together—Reference Color Space

Color management systems use a reference color space that acts as a bridge between profiles. A reference color space is an abstract mathematical representation of color in terms of what a human with normal vision can see. This space is generally much larger than the color space available on computer devices. No device is expected to be able to produce all the colors in this color space. The color space generally used as a reference color space is the CIE XYZ color space developed in 1931 by the Commission Internationale de l'Éclairage (CIE).

Reference color space is also called profile connection space (PCS). The CMS uses the information in the profile to translate the color from the profiled device into the reference color space. Once translated into the reference color space, it can be translated again predictably into any device that presents a profile to the color management system.

Device Independence

This ability to translate to and from any profiled device provides device-independence. In other words, a profiled device can talk to any other profiled device, no matter who the manufacturer is, through the CMS. This device independence gives you enormous choice in selecting hardware devices. Think how narrow your choices would be if you had to use only products from one vendor in order to successfully manage color.

Working Color Space

Color space profiles are used by some applications to establish a working color space that can be attached to a color image. Software applications like Adobe Photoshop and Adobe Illustrator are users of this technology. What is the benefit? Imagine that you are working in a group of two or more people that must share and edit color image files. Without a profile that describes the image, there would be no assurance that the colors I see and edit on my monitor would be the same as the colors that you see on your monitor, even if we had exactly the same equipment. Monitor calibration and profiling is a key step in reproducible color correction and is covered in another tutorial.

Another benefit of working in one of the standard color space profiles is that they are gray balanced. In other words, equal amounts of R, G and B will produce a neutral gray, black, or white. We'll see why this is important when we discuss color correction, another one of the basics you should understand to produce quality images.

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