Effect of lighting on digital camera profiling

By Michael Meyehofer

Objective

This study is intended to explore the appearance of various lighting conditions on digital camera profiles. It compares images taken with incandescent ambient lighting, flash lighting, and indirect studio strobes. The images are then reproduced with the correct custom ICC profile as well as the custom ICC profiles for the other two lighting conditions. This experiment provides an analysis for optimal color management settings for lighting conditions.

Procedures

Figure 1. Olympus E-20N

1. Digital photography
   A scene is taken of a Macbeth ColorChecker surrounded by colorful household objects using an Olympus E-20N digital camera (Figure 1). The same image is taken at a distance of 4 feet using three lighting conditions: incandescent room lighting, incandescent room lighting with a flash, and using a portable indirect studio strobe lighting kit. Settings on the camera were set to automatic to accommodate for proper white point, shutter speed, and aperture.

2. Digital camera profiling
   In addition to photographing the still image, a picture was taken of just the Macbeth ColorChecker to create an ICC profile for each lighting condition using Kodak ColorFlow software.

3. Image manipulation
   The three images, shot with different lighting, were taken into Adobe Photoshop 7.0 and applied the default (sRGB) profile as source to the press CMYK profile (Figure 2). The three images were also rendered with correct and incorrect source profiles to the press CMYK profile (Figure 3). The images were then cropped to 2 inches wide with a resolution of 300 ppi for pagination.

4. Pagination
   The three default (sRGB) profiled images are shown in Figure 2. Color-managed reproductions with correct and incorrect camera profiles are placed in a 3 x 3 image grid (Figure 3) for visual analysis. Together, they show many possible outcomes in color image reproduction.

5. Hardcopy output
   Plates are made on the CREO CTP system and the page is printed on the Heidelberg M-1000B offset web press. Consistency and accuracy are very important to properly access the results.

6. Visual analysis
   When evaluating the photographs the images with proper profiles appear more pleasing that those with the incorrect ICC profiles. The images taken under the indirect studio strobe lighting produces the best results.

Discussion

The scene was setup to contain critical testing areas. Colorful objects were used such as the Macbeth ColorChecker along with common items easily recognized like paint, color pencils, and rubber bands. A paintbrush and pencil holder were placed in the image to display the results on metallic objects. This arrangement provided a good source of tone and color for visual analysis.

You can see that each image, shown in Figure 2, had a slight fault due to the fact that the sRGB profile did not account for the effect of lighting. The incandescent image has a yellow colorcast and appears dull. The photo taken with a flash was blown out in certain areas. The indirect strobe photo also had a slight yellow cast to it and was a little dark. When properly corrected with the appropriate profile, these problems are resolved and acceptable reproduction are produced for all lighting conditions.

Figure 2. Color reproduction with the default (sRGB) source profile

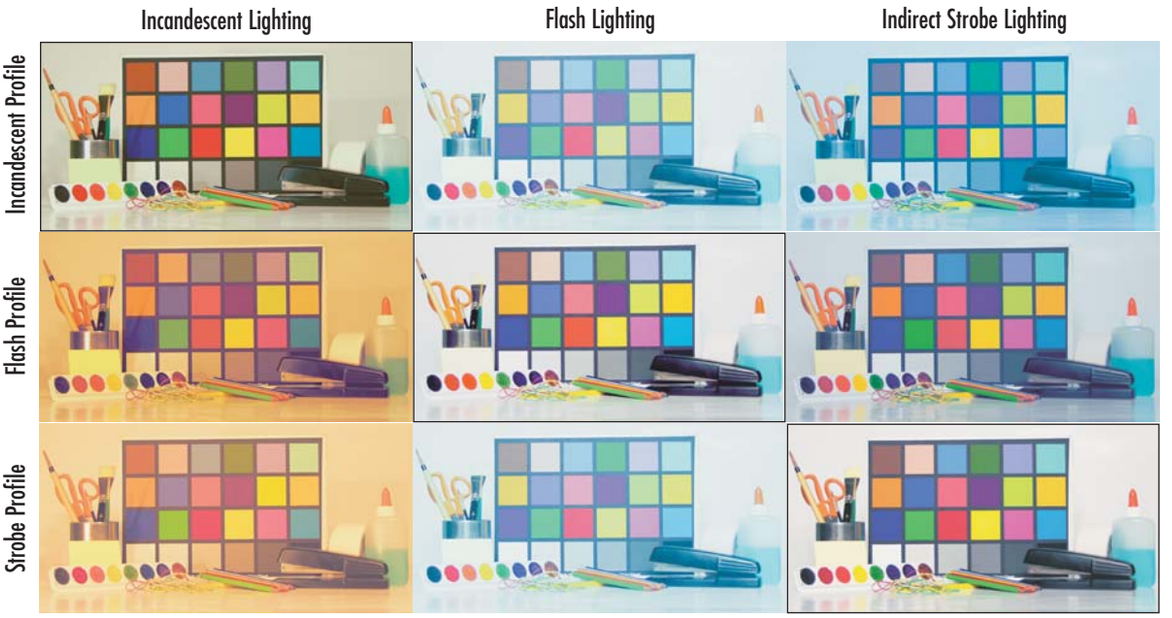

Figure 3. Color-managed reproduction with correct and incorrect digital camera profiles

Figure 3 shows the effect of color reproduction with correct and incorrect camera profiles. When applying the incorrect profile, it produces more harm than good. In this case all results of incorrect profiles made the image worse than that which it started. In the instance of the incandescent lighting, the image became even more yellow using the wrong profiles. The image taken with a flash was even more washed out and the strobe lit image was received a blue colorcast. Image detail was also lost.

The three diagonal images, shown in Figure 3, reproduced with correct camera profiles, should appear the same. But the results prove otherwise. The incandescent image (upper left) with the proper profile is darker than that of the other two correctly profiled images (middle and lower right). A proper camera profile should convert the image to adhere to the values of the ColorChecker. Further investigation and study may suggest why this inconsistency occurred.

Good reproduction begins with a good original. The lighting conditions must be accounted for in digital photography and camera profiling. This study concludes that still images are best produced with indirect strobe lighting and a specific ICC profile that is custom built for that lighting condition.

"Good Reproduction begins with a good original. The lighting conditions must be accounted for in digital photography and camera profiling."