



**Medical Photography task force
Teleconference
16 October 2014 • 10:00 (EDT)**

The meeting was called to order at 10:00 am (EDT) by Phil Green, with the following attendees:

James Chang
Max Derhak
Michael Flynn
Phil Green
Tom Lianza
Andy Masia
John Penczek
Hong Wei
Wei-Chung Chen
Kaida Xiao
Masahiro Nishibori

After a sound check, Dr Green introduced the main business of the meeting, which was the draft digital photography workflow document circulated in advance by John Penczek. He handed over the meeting to Dr Penczek, who introduced the document [see attached].

The main motivation for this document was to provide guidance on achieving better color accuracy in the initial image capture process, and other elements could be added later. The focus for now is to recommend procedure for medical photography taken in a controlled clinical environment, and other applications such as mobile could be considered later.

The proposed method recommends using a gray card to initially perform a manual white balance, as this can be more accurate than the automatic camera white balance.

Some camera manufacturers had indicated that a 'neutral' mode RAW format camera setting resulted in minimal perceptual enhancements introduced by the camera. It was agreed that camera RAW format was best for color accuracy.

Kaida Xiao noted that in his experience uniformity was very important, and was dependent on distance from the lens and other factors. Diffuse lighting was proposed as a means to minimize glare and specular reflection. It was noted that automatic uniformity correction can be used in some color correction software by utilizing color test charts (e.g. ColorChecker DG and SG) that include multiple white patches. Some members felt that more colours were needed than the 24-patch ColorChecker, but they should ideally be matte rather than gloss.

Tom Lianza reported that X-Rite make a book of flesh tone colour samples, and undertook to provide a reference.

Michael Flynn stated that daylight simulation fluorescent tubes had very spiky emission, and may not give good colour rendering. Different modalities may have different lighting configurations, and noted that Canfield Scientific (www.canfieldsci.com) specialize in such lighting configurations for medical photography.

The workflow document recommended HSL preset as one option, and Dr Penczek undertook to provide a definition of this.

This concluded the discussion and the meeting closed at 11:05

Action items from the meeting:

MIWG-14-xx Provide definition of HSL preset (Penczek)

Response: RAW file formats are specific and proprietary to each camera manufacturer. Adobe has created a RAW converter that takes the original RAW file and converts it into an open lossless raw image format called DNG. Some color correction programs use the DNG format to create a color correction profile in a manner similar to ICC profiles. However, other color correction programs attempt to match the colors in the color chart image and the reference values by adjusting the relative Hue, Saturation, and Lightness (HSL) values. These HSL preset values are then applied to all the images captured under the same conditions (as with ICC profiles).

Action items from previous meetings:

MIWG-14-23 Provide draft description of camera characterization procedure (Green)

MIWG-14-24 Provide reference to X-Rite flesh tone colour samples (Lianza)

MIWG-14-25 Consider providing a description of the calibration procedure (Vander Haeghen)

Recommended Image Capture Workflow for Medicine Photography

John Penczek

Oct. 13, 2014

Introduction:

This general procedure outlines a recommended digital camera image capture workflow that can be used to improve image color accuracy.

Required equipment:

- Digital color camera capable of exporting raw format image files. An ability to perform an in-camera white balance is also desirable.
- Reference color test chart (e.g. ColorChecker or Spyderchecker)
- Light source that can provide uniform illumination on the image plane at a 45 degree inclination angle. The light source should produce spectrally smooth broadband white light, approximating daylight.
- Software that is able to import RAW image files from camera, perform a white balance, and export the image in a 16-bit TIF format.
- Color correction software that can recognize each color in the reference color chart, create an HSL Preset file or ICC profile, and use this file to color correct the images of interest.

Procedure:

Image capture

1. Setup up the illumination and background for photographing the object of interest. The background should be a neutral gray color, ideally a 20% gray. The light source should produce light that is nominally at a 45 degree inclination angle to the image plane, and uniformly illuminating the entire region for the relevant image area.
2. Place a uniform gray target in the image plane. It should ideally be 20% gray. Skip this step if the camera does not have in-camera white balance capability.
3. Position the camera in front of the gray target and align the camera so that its optical axis is centered on the chart and perpendicular to it. It is best to use a tripod, or similar mechanism, to hold the camera stationary for the remainder of the photographs. Adjust the camera field of view so that it does not extend beyond the gray background. This field of view should be fixed for all photographs.
4. Use the in-camera white balance function to determine the proper white balance for this lighting condition. Use this white balance setting for all subsequent photographs. Skip this step if the camera does not have in-camera white balance capability.

5. Place the reference color test chart in the image plane. The camera field of view should capture all of the colors in the chart. The optical axis of the camera should be centered on the chart and perpendicular to it.
6. Set the exposure time to such that the brightest objects in the image are approximately 90% of the maximum brightness. The brightest object should be the whitest color patch. Use the intensity histogram (if available) to ensure that the image is not overexposed.
7. Capture the image of the reference color test chart and export the image in RAW file format. In some cameras, it is possible to use a “neutral” mode RAW format which minimizes perceptual enhancements.
8. Replace the reference color test chart with the objects to be photographed. Determine the proper exposure times for each object, and export the images in the same RAW file format.

Color correction

1. Import the RAW file of the reference color test chart into a program that is capable of performing a white balance on the image. Use the program to set the whitest color patch to an exposure of 90%, or RGB= 230, 230, 230. Then set the darkest patch to an exposure of 4%, or RGB= 10, 10, 10. If the black patch is below this level, then use the current setting or reshoot the photograph with brighter illumination. Export the white-balanced image as a 16-bit color TIF file.
2. Repeat this process for all of the other images taken under these image capture conditions.
3. Import the 16-bit TIF file of the reference color test chart image into a program that can recognize the reference color chart and create a HSL Preset or ICC profile based on that image. The color correction software should automatically find the centers of each color patch. Use colorimetric mode to create the HSL Preset or ICC profile.
4. Import the TIF files of the other photographed objects into the image editing program that is capable of using HSL Presets or ICC profiles. Apply the HSL Preset or ICC profile to each image and save the new color-corrected image in the desired format.