



Medical Imaging Working Group

The Westgate Hotel
1055 Second Avenue
San Diego, CA 92101
5 November 2016

Craig Revie, MIWG chair, opened the meeting at 13:45 and following self-introductions and a sound check for those on-line, he introduced the agenda as follows:

1. Introduction
2. Colour calibration for Petri dish imaging
3. Gjøvik masters course on colour in medical imaging
4. Updating FAQ 'How do I assess the accuracy of a display profile?'
5. Medical photography white paper
6. How to determine the gamut boundary of a display profile
7. Skin imaging update
8. Action items review

1. Introduction

Mr Revie gave the background to MIWG, and the initial meeting in conjunction with the FDA who recognise the importance of colour in medical imaging. Issues addressed so far by MIWG include calibration of whole-slide imaging scanners, medical displays (where Barco collaborated on development of ICC White Paper 44), skin imaging, mobile imaging (currently paused), and multispectral imaging, which is relevant to several imaging modalities such as WSI, Petri dish imaging etc. The MIWG web site is kept up to date and hosts a great deal of useful material.

2. Colour calibration for Petri dish imaging

Jeremie Pescatore provided an update in microbiology imaging [see attached]. His company, Biomerieux, have several partners in this work. The goal is essentially equivalence between manual and virtual (i.e. image-based) reading, with consistent diagnostic value. A calibration module computes a custom ICC profile, and CIECAM02 has been implemented to predict perceived colour. The system measures a spectral hypercube, and in the calibration they measure the spectral sensitivity of the sensor. The calibration tool is Matlab-based, and makes v2 Input class Lut profiles by calling Argyll. The calibration target is a colorchecker with additional colours from microbiology plates.

Dr Pescatore showed results from calibrating with both the target-based and spectral sensitivity method, with 240 training measurements. Accuracy was approximately 2 units of CIELAB 1976 colour difference, and the performance of the spectral method was equivalent to the chart-based method. Using training samples from microbiology in place of a standard calibration target gave better results.

Based on the results, Dr Pescatore proposed to develop a primer on microbiology calibration, together with three other White Papers. Open issues were that there may need to be reserved IP for the spectral calibration methods, the virtual target and the Matlab tool. Jack Holm stated that the methods are as described in ISO 17321-2.

Dr Pescatore stated that the camera sensitivity was measured with a monochromator, as this had been found to give better results than using Image Engineering IQ-LED system. The measurement includes the effect of the system optics.

He proposed to complete the primer for the next ICC meeting, with a draft by the end of December. It was noted that White Papers would need review within ICC and MIWG.

3. Gjøvik masters course on colour in medical imaging

Dr Phil Green stated that a new graduate course in Colour in Medical Imaging was being offered by NTNU in Gjøvik, Norway, as part of the European Erasmus Mundus Master programme on Colour in Science and Industry [see attached]. Projects in collaboration with vendors and institutions in medical field were welcome.

4. FAQ on display profile accuracy

Dr Green had developed a brief FAQ item at <http://www.color.org/faqs.xalter#pa6> on assessing the accuracy of a display profile, and at previous meetings it had been decided to expand this and develop a White Paper on the topic. There was no progress to report on this activity.

5. Medical photography white paper

The status of the document, now titled 'Improving Color Image Quality in Medicine Photography', was summarised. Dr John Penczek had provided a complete draft [see attached] which includes all the previously outstanding sections and some new material, and this had been circulated prior to the meeting.

The MIWG page on this topic had been updated with some additional example images, and Yves Vander Haeghen proposed adding more images which he undertook to provide.

The main comment from the meeting was that the recommended procedures for scene-referred camera output are already described in TC42 standards especially ISO 17321.

It was noted that some cameras such as the iPhone7 were able to save DNG format images, which would support RAW processing for such devices which normally just save rendered JPEGs.

The following undertook to review the draft and provide comments: James Vogh, Eric Walowit, Jack Holm, Ray Cheydleur, and Chris Bai.

6. Display profile gamut

It had been suggested that it would be useful to develop an FAQ on determining the gamut of a display. Dr Green had prepared a draft FAQ at <http://www.color.org/displaygamutfaq.xalter>, and comments are welcome. It was suggested that an iccMAX gamutBoundaryDescType should be included.

7. Skin imaging

Dr Kaida Xiao presented an update of the work on skin imaging [see attached], which is being undertaken within a CIE TC. He summarised the objectives and described the value of having spectral reflectance rather than colorimetry. In his approach the camera sensitivity functions provided a basis for estimating reflectance, using the skin spectral database the method and PCA to determine basis functions. His results showed that

this gave better results than a two-step method and preserves skin spectral reflectance well. One application currently is to look at the reflectance before and after exercise.

The meeting discussed the spectral measurement procedure used to provide training data. Dr Xiao stated that both specular included and excluded measurements had been made, and in contact measurements the effect of pressure was negligible. It was difficult to conclude whether a TSR was better than a spectrophotometer for this purpose. The error was typically below 3 units of CIE 1976 colour difference.

Dr Holm stated that in his experience a TSR gave better results, and the scattering was illumination dependent. The difference between a calibrated camera and a TSR was generally around 1.5 units in CIELAB colour difference.

One goal of Dr Xiao's work was to match silicone-based prosthetics, although it was acknowledged that human skin has different scattering and reflection properties to synthetic materials. He stated that the CIE TC will close in 2017, and the full reflectance spectra would be made publicly available in 2017.

8. Action items review

Craig Revie reviewed outstanding MIWG action items [see attached]. Many were closed, and the meeting discussed the following:

8.1 MIWG-15-34 Provide input on calibration errors using different types of training sets (Holm / Walowit)

Dr Holm and Dr Walowit stated that they have test functions, and their experience was that different training sets do affect the maximum errors. The meeting noted that it was a goal to cite published result which support this.

8.2 MIWG-16-11 Provide document on camera calibration research project for ICC web site (Vander Haeghen)

Dr Vander Haeghen agreed to provide this (possibly edited due to IP).

8.3 MIWG-16-12 Discuss ICS for GSDF and report back to MIWG (Bai, Derhak, Nagashima-san and Kimpe)

Chris Bai undertook to lead on developing the ICS

There being no further business, the meeting closed at 17:00.

Action items

The following action items were agreed at the meeting:

- MIWG-2016-20 Distribute draft primer on Petri plate system calibration by December 2016 (Pescatore)
- MIWG-2016-21 Provide liaison copy of draft ISO TR on scene-referred camera output (Walowit)
- MIWG-2016-22 Post further images on Medical Photography (Vander Haeghen, Green)
- MIWG-2016-23 Review draft guidelines for medical photography (Vogh, Walowit, Holm, Cheydleur, Bai)
- MIWG-2016-24 Develop FAQ item for determining display gamut boundary with iccMAX gamutBoundaryDescType (Green)