

CIE TC 8-16 meeting in Vancouver – meeting notes

12th November 2018

Attendees (TC members): Craig Revie, Yasuki Yamauchi, Marc Mahy, Po-Chieh Hung, Andreas Kraushaar, Jaqueline Wittmann, Don Hutcheson, Muhammad Safdar, Peter Nussbaum, Danny Rich [10]

Attendees (observers): Marco Mattuschka (DE), Alp Durmus (AU), Klaus Richter (DE), Cedric Blatter (CH), Semin Oh (KR), Mikael Petterson (SE), Alan Hodgson (UK), Rafael Huertas (SP), Arhum Sultana (CA), Thomas Bangert (UK) [10]

Presentations are available on the [ICC web site](#) and from COLTOOL in the 'Meeting records' folder.

The recording of the meeting is also available from [the ICC web site](#) (ICC login required).

Introduction (Craig Revie)

See **0. 20181112 CIE TC 8-16 Agenda.pdf** for details of how to access the CIE COLTOOL area and documents on the ICC web site.

Current status

- We are now almost half way through the 4 years planned for this TC
- Some research work has been completed
- Several additional research projects are planned
- Some of these results and future plans will be presented today

Input and suggestions (and participation) from attendees was invited

Research projects

A short summary of each project was followed by detailed presentations from each of the researchers.

Introduction to Fogra research project

Fogra has developed an experiment to test currently available algorithms that claim to maintain Consistent Colour Appearance for colour conversion for print. The goal is to order these algorithms according to their ability to maintain Consistent Colour Appearance across a given set of colour gamuts.

A set of reference RGB images are converted to a set of CMYK print gamuts. The RGB images and print gamuts are defined by ICC Profiles. Several mapping strategies use ICC Perceptual Rendering as defined by the ICC Profiles created by different vendors and two mapping strategies use proprietary algorithms. A number of pair comparisons between two sets of images were conducted and the results analysed to determine the relative performance of each algorithm.

These colour algorithms can then be compared with various hypotheses for CCA. One option that shows particular promise uses colour naming boundaries. The hypothesis is that consistency of colour appearance is higher when the number of colour naming boundaries crossed is lower.

This could provide a way to determine whether any given colour rendering algorithm provides better consistency of colour appearance compared to a reference algorithm.

See Fogra presentation by Marco Mattuschka and Jaqueline Wittmann

Notes on Fogra presentation

Project: Jaqueline will leave Fogra mid-January and Marco will complete this project.

Ethnic bias: Mikael suggested that it would be a good idea to check that there was no ethnic bias in the assessment as, for example, Asian printers prefer more saturated colour. This can be addressed by repeating the experiment on different sites. Fogra plans to make the project materials available so that this can be done easily.

Fogra web site: Fogra has created an area on their web site for CCA. See www.fogra.org and then follow the links for Research :: Prepress :: Research Projects :: Common Appearance. This page provides a summary of the CCA project. There are then three further areas:

- *FOGRA53:* details of a new colour space designed for exchange of colour documents intended for print.
- *Publications:* all of the presentation made by Fogra on this topic can be found here along with a white paper describing the experiment to determine whether CCA exists.
- *CCA web tool:* this area is not yet complete but will provide a web tool for assessment of CCA.

Introduction to NTNU research project

A study is being conducted at NTNU which will test the hypothesis that the ICC Relative Colorimetric with BlackPoint Compensation colour rendering algorithm ensures consistent colour appearance.

This will be tested using a set of reference source images and three colour gamuts of different size. The reference source images were converted to each of the three colour gamuts using RC+BPC to form a reference set of rendered images. Several variant images were created by adjusting lightness contrast, chroma, and hue of the reference source images.

Two different sets of images are shown to observer at a time and he/she is asked to scale consistency of colour appearance in terms of colour difference in the range 0-10 where 0 means ideal reproduction as per observer's own perception (memory). The set with the lowest score is retained as an anchor point and the second set is replaced with a different variant set.

See NTNU (Gjøvik) presentation by Muhammad Safdar.

Notes on NTNU presentation

Surprising result: a number of attendees commented on one of the results presented which appears to show that observers most preferred the set of samples with no change in contrast but with both hue and chroma increased. This seems counter-intuitive and Muhammad agreed that this required further investigation. The result in second place had increased lightness and chroma but no hue change.

Introduction to RIT research project

The RIT project builds on many years of printing experience. Traditional printing systems have evolved so that a CMYK image printed on one system looks similar when printed on another. I suppose 'survival of the fittest' applies. In recent years this has been formalised by a system known as near-neutral press calibration or G7 and standardised as ISO/PAS 15339.

The project team at RIT have designed a set of synthetic print gamuts (CMYK) that are defined using the principles of near-neutral press calibration. These gamuts have primaries and secondaries at the same hue angles, use tone reproduction curves that follow the near-neutral press calibration aims and their gamut surfaces are spaced by approximately the same CIELAB distance.

The hypothesis is that CMYK images have Consistent Colour Appearance for this set of synthetic colour gamuts. If so, this would provide a method to generate sets of images with CCA for further study and in addition could be used as the basis for a CCA metric for printing systems.

Second observation: For some kinds of colour adjustment, the 95th percentile of the colour difference between two images is 'significant'. This provides an efficient method for the creation of variant images

See RIT presentation by Don Hutcheson (Elena Fedorovskaya was unable to join this meeting)

[Notes on RIT research project](#)

Novices vs experts: the results show that novices judge print differently from experts. Don commented that 'experts' covers a range including printers and print buyers. Further testing will use a more inclusive set of images and will use soft proofs shown on displays instead of hard copy prints.

[Introduction to Yamagata University research project](#)

Yamagata University plans to build on previous work done which identifies a set of trend lines in CIELAB colour space.

The initial set of trend lines used the colour gamut boundaries of the ISO/PAS 15339 colour gamuts. There has been some discussion as to whether the use of gamut boundaries in this way artificially influences the trend lines. In a repeat of this experiment, a new set of trend lines will be identified that avoid this constraint of colour gamut boundaries.

A trend line is developed for a single colour in several steps. In each step, observers are asked to select a colour that is a fixed CIEDE2000 colour difference from the previous colour, has a similar appearance but is less saturated. By repeating this process, trend lines can be generated for a set of saturated reference colours.

The hypothesis to be tested by Yamagata University is that consistent colour appearance is maintained for images when image colours are mapped along these colour trend lines.

See Yamagata University presentation by Yasuki Yamauchi

[Notes on Yamagata University research project](#)

Constant hue: Po-Chieh asked whether the trend lines follow constant hue lines. The trend lines were constrained by gamut surfaces which may influence the observer choices. In some cases, this may be a severe constraint.

Repeating the Fogra experiment: Yasuki-san said that if possible, he would like to repeat the Fogra experiment. Jaqueline said that they currently have version 1 of the experiment available but are planning to make the second version available but not on the public area of the web site.

[Technical Report, proposed structure and anticipated conclusions](#)

An outline of a proposed TR has been circulated and comments are invited. We discussed the timeframe for this and discovered that the time from having a draft that has been agreed by the TC to the time of publication is likely to be more than 6 months. This schedule was reflected on the updated project plan.

[Next meeting](#)

A [Doodle poll](#) has been set up to find the best time early in January.