

CIE Division 8

Technical Committee 8-03: Gamut Mapping

Minutes of 6th November 2000 Meeting in Scottsdale, AZ, USA

Compiled by Todd Newman

1. Attendees

Attendees are listed in alphabetical order and TC 8-03 members are marked with a *.

Tony Johnson *

Al Kravetz

Hideto Motomura *

Todd Newman (Division Director,
Meeting Chair) *

Pei-Li Sun

Geoff Woolfe *

2. Agenda

The meeting began at 9:00. The following agenda was agreed to:

1. Workflows
2. Test images
3. How standard might be implemented
4. Device characterization
5. Schedule
6. Action Items

3. Workflows

We read through each of the proposed workflows. The ROMM RGB workflow derives from an architecture developed by Spaulding, Woolfe, and Giorgianni at Kodak. Capture devices capture a larger gamut and dynamic range than can be reproduced on any output medium. Mr. Woolfe explained that the goal is to keep the large gamut until the last minute. The idea is to capture a representation of scene colorimetry, by undoing the processing that is built into the camera. That is, one takes out the capture device characteristics to get to RIMM. One then renders RIMM to ROMM to handle differences in viewer adaptation (such as luminance and viewing flare), but not differences in white point or compression into the output medium.

Mr. Johnson observed that it is hard to undo the device processing, unless you know the characteristics of the camera. Mr. Woolfe explained that if you cannot un-build the camera image, you take the camera colorimetry and put it directly into ROMM.

Mr. Woolfe made a distinction between rendering and gamut mapping. He uses rendering to mean compensation for differences in viewing environments. Gamut mapping is compensation for differences in the range of colors devices can produce. He then observed that we must be careful about what we are comparing when we compare experimental results. Suppose an image is being output to a range of printers. A certain fraction of the image will be out of gamut for a given printer, but different ranges will be out of gamut for different printers. When we compare results, we may

see one GMA performing well on a printer simply because that printer has a large gamut.

(Kodak doesn't use color appearance modelling to do rendering, but you could. Paula Alessi's looking into it. Cf. Jack Holm's issues.)

He also raised a question about what the reproduction intent should be for gamut mapping. This led to a discussion about people being more critical of hue shifts in wedding photo than with business graphics. Mr. Sun said that if we are using natural images, preference and accuracy almost the same thing. In business graphics, asking people about accuracy and preference will yield very different results.

Mr. Woolfe raised some interesting issues with gamut mapping from transparency to print. The problems arise because of the substantial differences in the viewing environments. Because of these differences, images must be re-rendered as well as being gamut mapped. But that means that for a fair test of gamut mapping, you would have to have the observer viewing the re-rendered transparency versus the gamut-mapped transparency, which is impossible for them to do. Mr. Johnson agreed and said that typically you just combine these into one transform. So it will not be easy to combine results from the transparency to print workflow with those from the CRT to print workflow. So we will need a recommendation on re-rendering transparencies and gamut mapping transparencies.

The attendees felt that we should drop the 'transparency to CRT to print workflow' path. It would basically be the same as the CRT to print path.

Mr. Newman observed that the different workflow scenarios are strong in different places and thin in others. It would be good to combine the best features of each.

Mr. Woolfe proposed that we could provide a set of test image suitable to all the workflows. We would start with a transparency, un-build to scene space, render to ROMM, and then render that for a CRT. This works well enough for natural scenes, but Mr. Newman wondered what to do for business graphics. Mr. Woolfe said one could make a business graphic using Pantone colors with gamut outside inkjet. If we made a file in Illustrator we could make business graphics files with. On reflection, however, the group as a whole felt that most business graphics originate on a CRT and the workflow scenario should only be applied there.

4. Test images

The group agreed that we must have at least two obligatory images in order to allow us to relate interval scales from different experiments. There was a strong feeling, however, that it would be better if we shared more test images than that. (At this point, a mention was made to a paper by Urabe, which presented a method of combining rank order and paired comparison with fewer tests.) Mr. Woolfe suggested we have six compulsory images and a library of others. The XYZ SCID images are a good source for business graphics. He volunteered that Kodak could provide the six obligatory images and maybe a CD of 30-40 possible other images.

Mr. Johnson would like to see newsprint as a test medium.

5. How standards might be implemented

Mr Woolfe wanted to know how and where a standard gamut mapping algorithm might be implemented. He said that Kodak would not to use a common gamut mapping algorithm for all images. For example, the user wanting an accurate reproduction

for a work of art would have different needs than a consumer wanting a preferred reproduction of a snapshot.

Mr. Newman said that he expected this would be integrated into standards mostly through the work of the ICC. The ICC Research Implementation Working Group is looking for a consensus of opinion among experts. This would become the basis of their proposal for a baseline ICC architecture.

Mr. Woolfe said that we need to encourage the ICC to educate people on what these things are good for. Mr. Kravetz said that the ICC is preparing a presentation for non-members on color spaces. There will also be more detailed, expert-level information prepared by the ICC for its members.

6. Device characterisation

Mr. Johnson asked if we need an agreed-upon printer characterization process. He felt that otherwise, we might be assess the difference in GMAs based on differences in device characterization. The group agreed. It also felt that we need to define how to define the gamut boundary. Mr. Woolfe said that Kodak engineers like alpha shapes, rather than a convex hull, because they have smaller errors. Mr. Woolfe said he would be happy to write a brief description of the characterization process and work on it with Mr. Johnson. Mr. Johnson said that Phil Green at the London College of Printing has been looking at a more specific technique for describing the gamut boundary.

Mr. Newman said that he would work on releasing the ICC RI stuff. This might serve as a framework into which device characterization algorithms could be plugged. In particular, that framework already includes an implementation of alpha-shapes for gamut boundary description.

7. Schedule

The group expected the following organizations would conduct experiments on gamut mapping: Derby, London College of printing, Canon, and Matsushita. Kodak might fund a student at RIT. hope that others will volunteer as well. There will be Japanese CIE meeting after this one. Mr. Motomura will look for JCIE to participate as well.

Test Images	January or February, at the latest
Next round of document	End of February
Closure on the document	End of March
Run experiment	March through October
Present results	Next Color Imaging Conference
Evaluate experiments	March 2002

8. Next Meeting

Tony Johnson will produce standardized instructions for experimenters. He'll also produce a standardized response form: including things like age, gender, race, of observers. He will also include space for comments on what affected the decision.

Mr. Johnson and Mr. Woolfe will also define a characterization procedure. It will also include a method for creating gamut boundary decisions.

Geoff Woolfe and Gus Braun will provide standard transforms from ROMM RGB to XYZ and CIELAB. They will provide both MATLAB and C code. Also, they will provide test points. (Geoff and Gus).

Mr. Newman committed to the following:

- share MATLAB code for Rank order.
- revise workflows for different media and integrate the best features of each description into the others.
- propose some computer business graphic images for evaluation..