

CIE TC 8-16

Consistent Colour Appearance (CCA) in a Single Reproduction Medium

Workshop in Yamagata University

24th April 2017

W Craig Revie

Overview



A

Increasing gamut size →



B

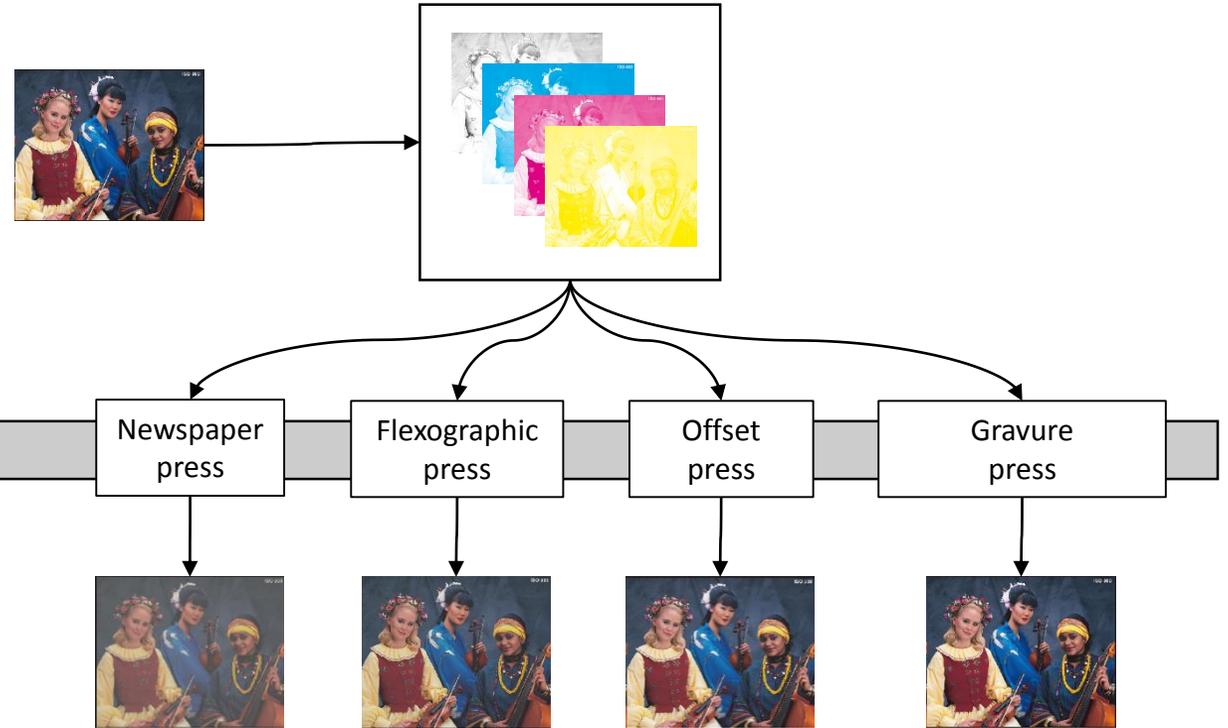
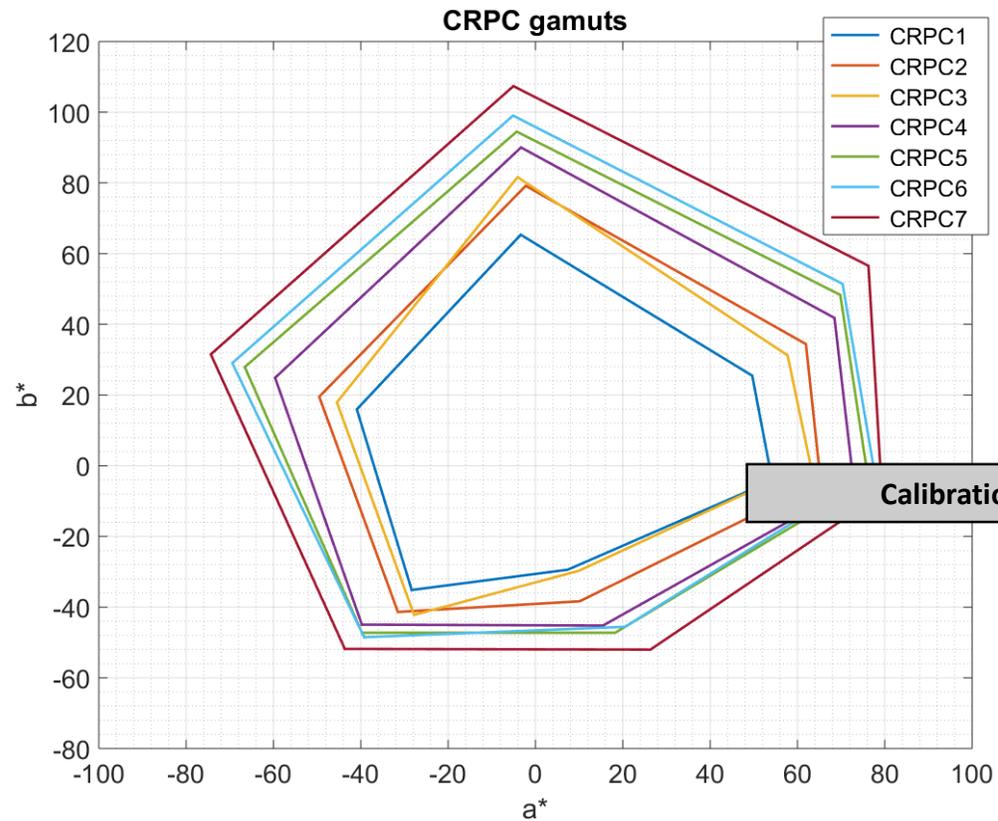
Q1: why do images in set B have a similar appearance whereas the images in set A do not?

Q2: is the degree of similarity of a set of images something that could be measured?

Q3: are all observers in agreement as to when Consistent Colour Appearance is achieved?

Why would such a metric be
useful?

Characterised Reference Printing Conditions (ISO/PAS 15339)



Consistent colour appearance?

Flexible print (RGB) workflow



Print contract is agreed based on a **reference display image** or **prototype print** from a standard digital printing system



RGB

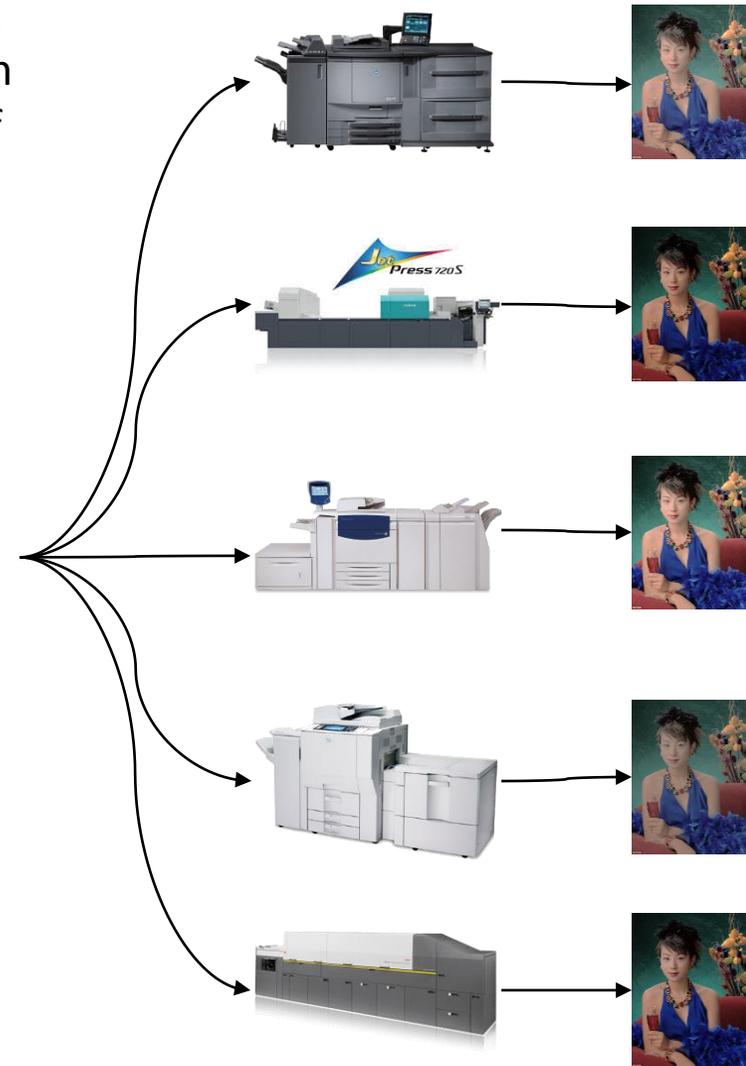


Printing should use all of the available printing gamut but must retain colour appearance of agreed reference



RGB

Colour conversion



Consistent colour appearance?

Initial target for CIE TC8-16

Brand management



Product packaging



Magazine advert



Newspaper advert



Billboard advert

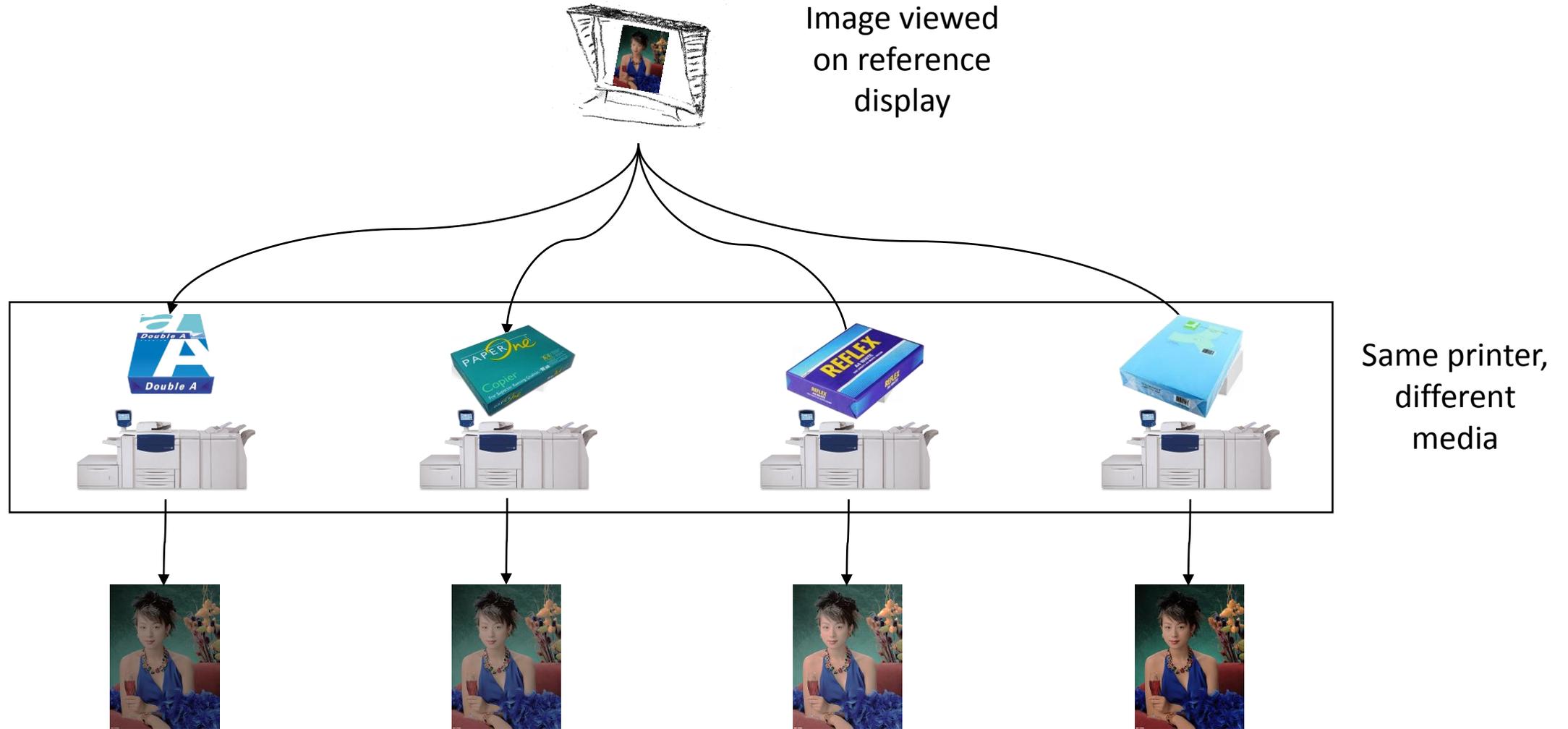


Vehicle wrap



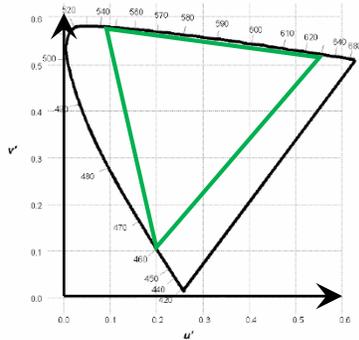
Television / internet

Consistency across different print media



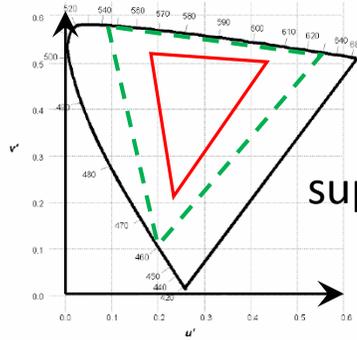
Consistent colour appearance between prints and with display image?

Consistency across displays (UHDTV)

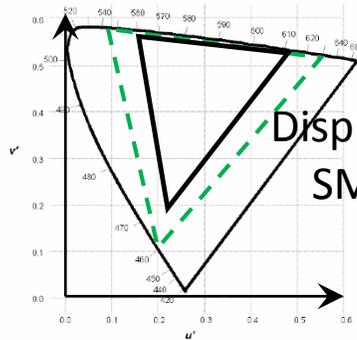


Transmitter uses BT.2020 encoding with very large colour gamut

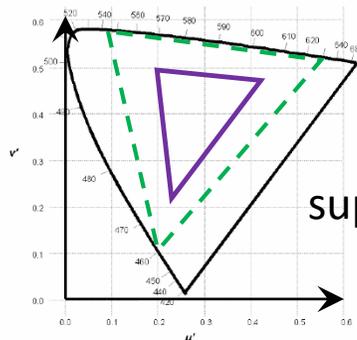
What is needed to achieve consistent colour appearance?



Display A supports BT.709



Display B supports SMPTE DCI-P3



Display C supports sRGB

Activities

CIE Reportership R8-13 Co x

www.color.org/resources/commonappearance.xalter

International Color Consortium
 MAKING COLOR SEAMLESS BETWEEN DEVICES AND DOCUMENTS

ABOUT ICC RESOURCES INFORMATION MEMBERS GETTING STARTED V4 iccMAX

ICC: EVENTS:

All ICC Events

2017

Tokyo, April 19-20

Prague Graphic Arts Experts' Day, June 29

Upcoming ICC Meetings

2016

2016 ICC DevCon

ICC Meetings, 4-5 Nov San Diego

Medical Imaging, 5 Nov San Diego

Displays & 3D print, 5-6 May Taipei

ICC Meetings - Taipei

Print Business Outlook Conference, Mumbai, March 15

NPES-ICC Color Management Conference, Jakarta, March 17

2015

iccMAX Webinar April 22

Medical Imaging Experts Day Mar 4

Other ICC Medical Imaging meetings

NPES-ICC Color Management Conference Feb 12

■ ICC Specifications

■ Technical Notes

■ ICC Resource Center

■ ICC Slide Presentation

■ ICC Logos

CIE Reportership R8-13 Common Colour Appearance

Reporters: Craig Revie (Fujifilm), Yasuki Yamauchi (Yamagata University)

This reportership is now closed and a CIE Technical Committee will continue this work. This Technical Committee will follow the CIE rules for confidentiality which does not permit general disclosure of documents. **Should you wish to join the Technical Committee, please contact one of the committee chairs (Craig Revie or Yasuki Yamauchi).**

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When a set of colour reproductions are judged to have a high degree of similarity, they are often said to have a 'Common Colour Appearance'. The degree of similarity is generally judged by subjective assessment. Although this term and similar terms are widely used it has no clear definition and there is currently no standard means of assessing whether a set of colour reproductions has common colour appearance.

For this reportership we plan to describe some example cases where sets of images share a common colour appearance and propose assessment methods that could be used to explore this idea further. One objective is to determine whether common colour appearance is a shared concept across observers and, if so, whether the degree of colour similarity of a set of colour reproductions can be measured objectively.

Images that are colour matched have a 'common colour appearance'. Colour matching, including media-relative colour matching is widely used for print production today but has a serious limitation when reproductions are to be made across a range of printing systems and displays as the reproductions must use the smallest colour gamut of all of the systems. The aim of this project is to explore ways of using the full colour gamut of all systems and at the same time retain common colour appearance.

This work is being done as part of CIE Reportership R8-13 Common Colour Appearance with a view to establishing a CIE Technical Committee to develop suitable objective measures.

A set of **test images** have been proposed for use in research on this topic. A set of **print gamuts** are recommended for testing.

NTNU Workshop on Consistent Colour Appearance
 NTNU in Gjevik, Norway
 9 January 2017, 9:00am - 12:00am

Agenda

Start time	Presentation
14:43	Outline of CIE technical committee (Yasuki Yamauchi)
48:15	Research at NTNU on Consistent colour appearance (Greg High)
01:26:52	Research at Yamagata University (Yasuki Yamauchi)
02:20:27	Methods for measurement of consistent colour appearance (Yuteng Zhu, Zhejiang University)
02:28:13	Psychophysical experiments for determining consistent colour appearance (Shining Ma, Zhejiang University)
02:55:19	Reflections on experiment for media-relative gamut mapping (Theresa Deschner)

Start times indicate the time the presentation started in the **meeting recording**.

Pre-TC meeting of the CIE Common Colour Appearance Focus Group (R8-13)
 Westgate Hotel, San Diego, California in conjunction with IS&T/CIE 24

SEARCH ICC: GO

Got a question about ICC Profiles or colour management?  Ask Phil...

ICC: LIVE TOPICS:

- iccMAX
- New ICC video
- iccMAX Reference Implementation - v2.1.7 released
- Research fund
- ICC Medical Imaging Working Group
- Profile security
- New ICC White Paper on visualisation of colour on medical displays
- Display calibration
- New PRMG-based exchange profile for digital print
- Profiling tools
- ICC Profile Registry
- sRGB profiles
- ICC user forum
- Why join ICC?
- What is an ICC Profile?
- Using CxF for printing spot inks
- What is FOGRA39?
- Consistent colour appearance

CIE - INTERNATIONAL COI x

www.cie.co.at/index.php/Technical+Committees

TC 8-16: Consistency of Colour Appearance within a Single Reproduction Medium

To study and report on sets of reproductions of the same source image that have a consistent colour appearance and are most similar to a reference reproduction, including recommending assessment methods that measure the similarity of reproductions of an image with different colour gamuts, for printed images on substrates with approximately similar characteristics in a fixed viewing environment. Only the effect of colour reproduction on appearance will be considered by this TC and so the assessment will be performed using hard copy or soft copy proofing. To propose a metric which can measure consistency of colour appearance.

Chairs: [Craig Revie](#) (GB) & [Yasuki Yamauchi](#) (JP)

<http://www.cie.co.at/index.php/Technical+Committees>

<http://www.color.org/resources/commonappearance.xalter>

CIE TC 8-16 members

Claas Bickeboeller	CH	Danny Rich	US
Yuan Jiang Ping	CN	David McDowell	US
Andy Kraushaar	DE	Elena A. Fedorovskaya	US
Nikolaus Pfeiffer	DE	Max Derhak	US
Philipp Tröster	DE	Michael Brill	US
Christine Fernandez-Maloigne	FR	Po-Chieh Hung	US
Yasuki Yamauchi (chair)	JP	Robert Chung	US
Peter Nussbaum	NO	Timothy Baechle	US
Phil Green	NO	Dirk De Bayer	BE
Craig Revie (chair)	UK	Marc Mahy	BE
Gregory High	UK	Jürgen Seitz	DE
Jan Morovic	UK	Chris Bai	TW
Ronnier Luo	UK	Qianqian Pan	UK

Key dates

- | | |
|----------------|---|
| 9 Jan 2017 | NTNU Workshop on Consistent Colour Appearance |
| 2 Mar 2017 | TC 8-16 "Consistency of Colour Appearance within a Single Reproduction Medium" fulfilled all requirements to be active according to the CIE CoP |
| 24 Apr 2017 | Mini Workshop on Consistent Colour Appearance in Yonezawa (Yamagata University) |
| 1 Jun 2017 | RIT Workshop on Consistent Colour Appearance within a single medium (day will include a tour of the Munsell Color Science Lab) |
| TBD 5-7 July | Virtual CIE TC 8-16 meeting |
| 11-15 Sep 2017 | Face-to-face meeting in conjunction with IS&T CIC25 in Norway (Lillehammer or Gjøvik) |
| TBD Jan/Feb 18 | Virtual CIE TC 8-16 meeting to finalise details of evaluation method |

Assessment method

Objective: CCA of printed images

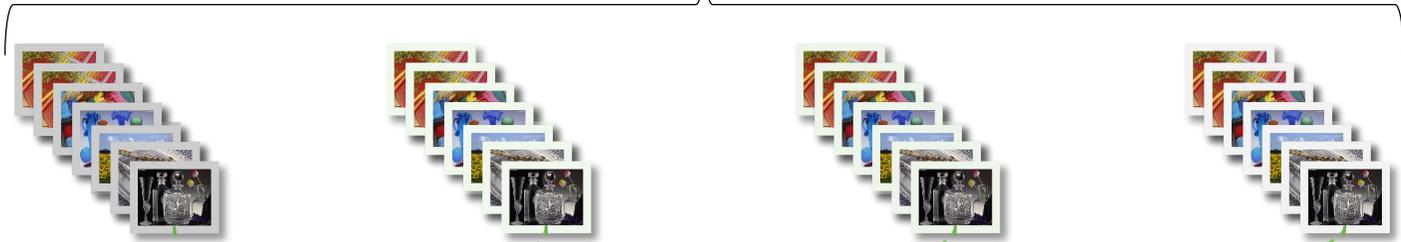


Production Printers
Includes media, inks and printer configuration

Reference Printer
Includes media, inks and printer configuration



Reference Prints

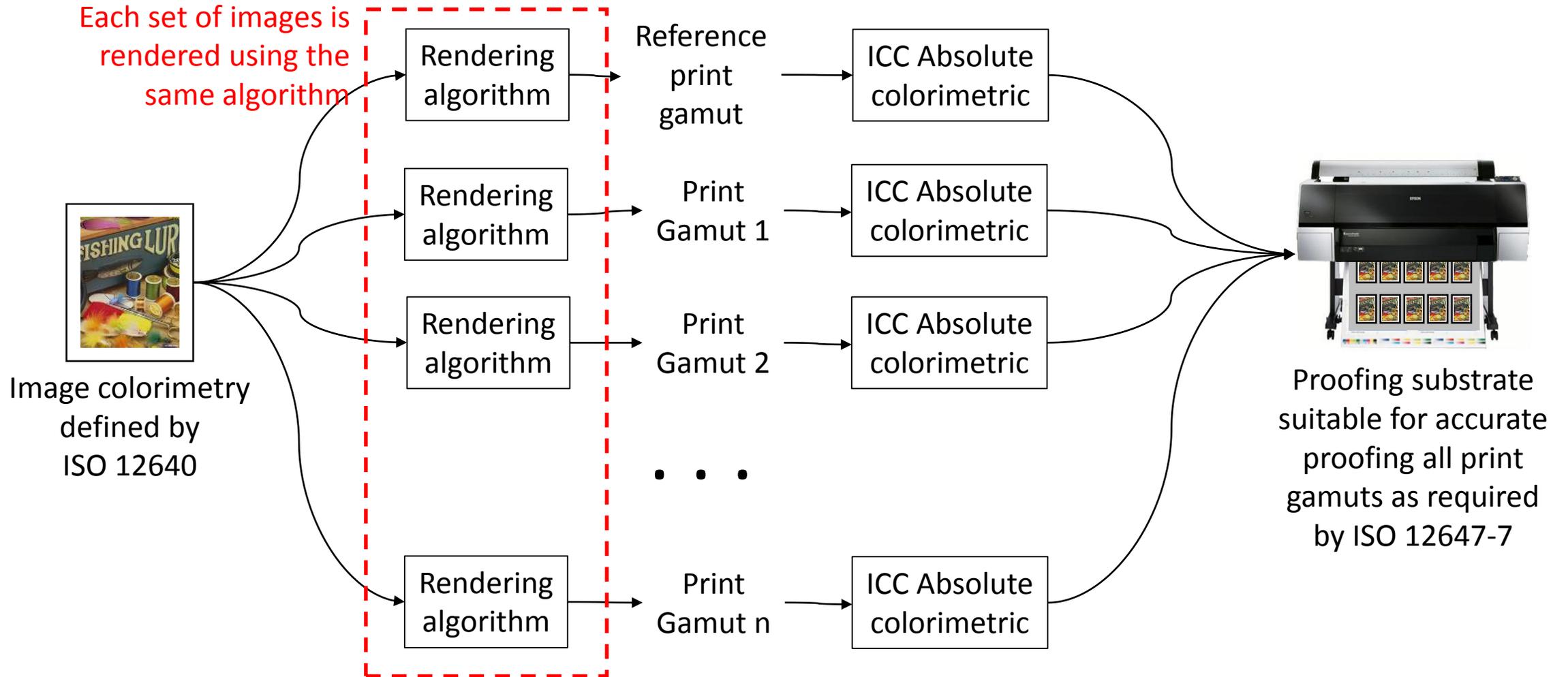


Print measurement and assessment

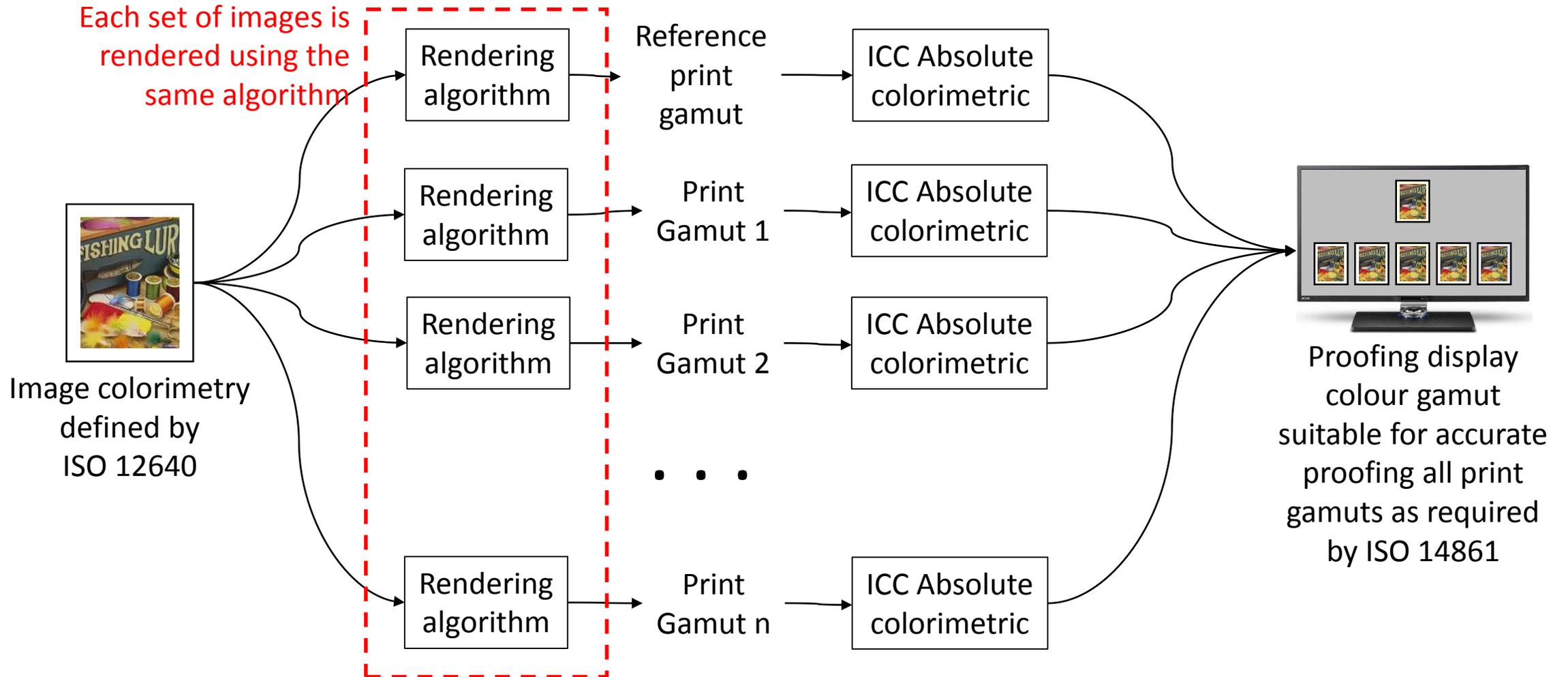
Consistent Colour Appearance Metric



Use of print gamuts (hard copy)



Use of print gamuts (soft copy)

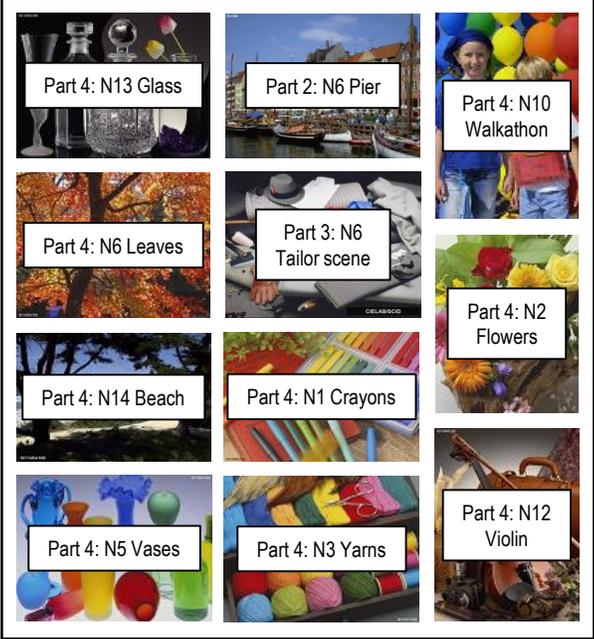


Resources

Candidate images (ISO 12640 SCID)



Primary image set



Secondary set

Images should be printed at approximately the same size

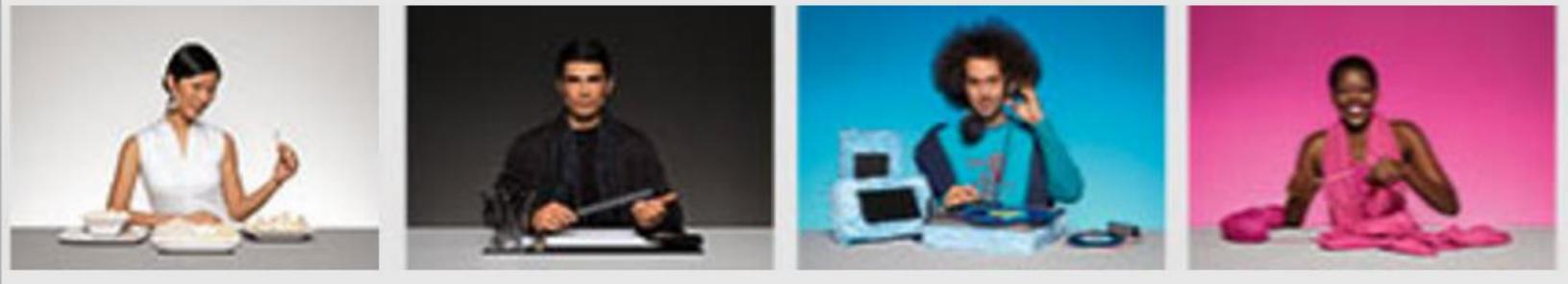
See http://www.color.org/resources/r8-13/CCA_test.xalter

Proposed additional / replacement images (Roman16)

Additions to primary set

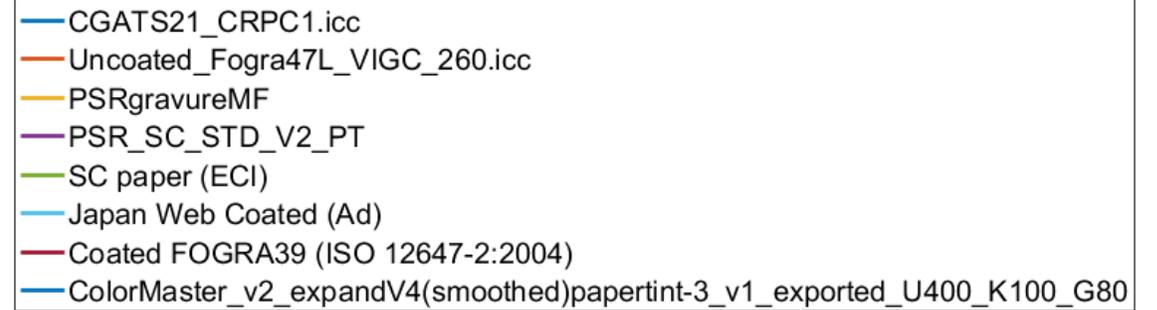
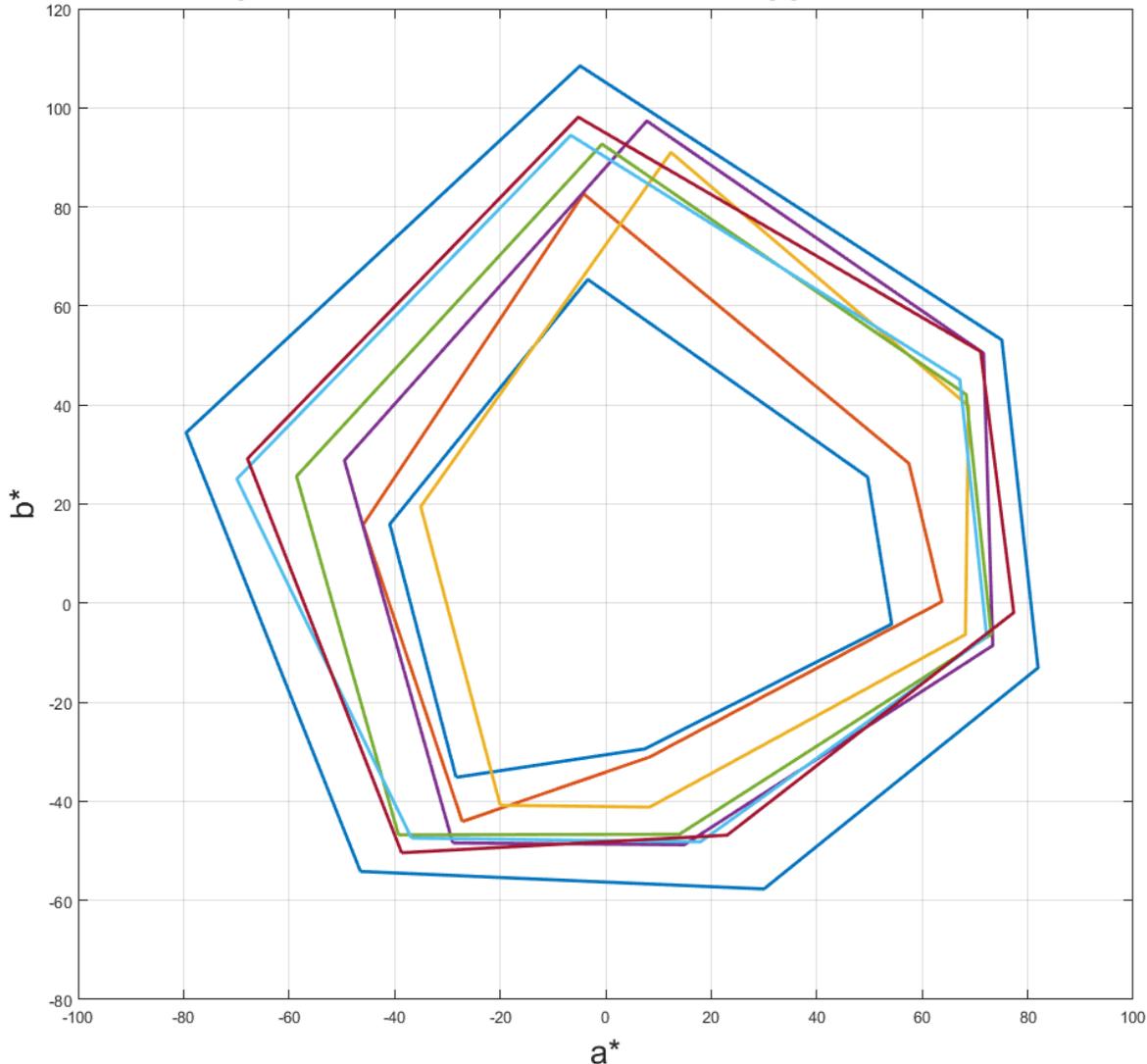


Additions to secondary set



Candidate print gamuts

Candidate profiles for Consistent Colour Appearance assessment



CGATS21 CRPC1: [ICC profile registry](#)

Uncoated Fogra47L: [ICC profile registry](#)

PSR Gravure MF: [ECI web site](#)

PSR SC STD V2 PT: [ECI web site](#)

SC paper (ECI): [ICC profile registry](#)

Japan Web Coated (Ad): [Adobe web site](#)

Coated FOGRA39: [Adobe web site](#)

ColorMaster / Fogra53-5: [Fogra web site](#)

Note: it is not intended that these profiles should be used for rendering directly to CMYK. The associated characterisation data may be used directly but with some care the A2B1 tables (Absolute Intent) can be used to determine the colour produced by each CMYK combination

Viewing conditions

Viewing environment



- ISO 3664:2009 Viewing conditions
- P2 viewing condition
- CIE Illuminant D50
- 500 lx +/- 125 lx (same as ICC PCS)

Hard copy proof



- ISO 12646:2008 Display characteristics and viewing conditions
- ISO 14861:2015 Requirements for colour soft proofing systems
- Display colour gamut must be large enough to simulate all reference print gamuts

Soft copy proof

Conceptual tests

These tests may be too complex and it may be better to consider a number of simpler tests for different aspects of Consistent Colour Appearance

Example document preparation

- tests **default ICC Perceptual reproduction**

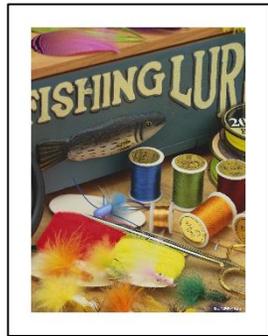
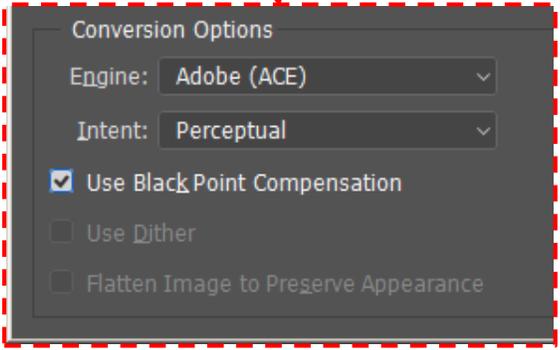
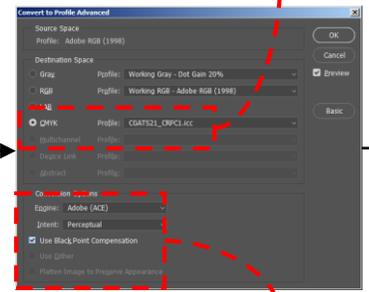
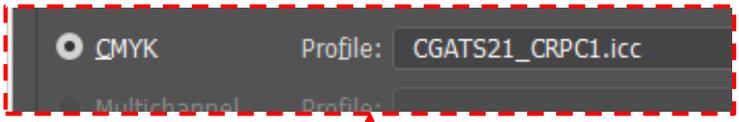
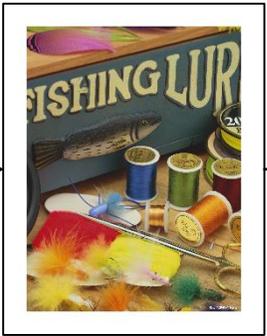


Image prepared by adding white border and assigning appropriate ICC Profile - in this case AdobeRGB (1998)



Adobe Photoshop 'Convert to profile' used to convert to reference print ICC Profile, in this case CGATS21_CRPC1



Munsell N5 grey background at least 2x white margin

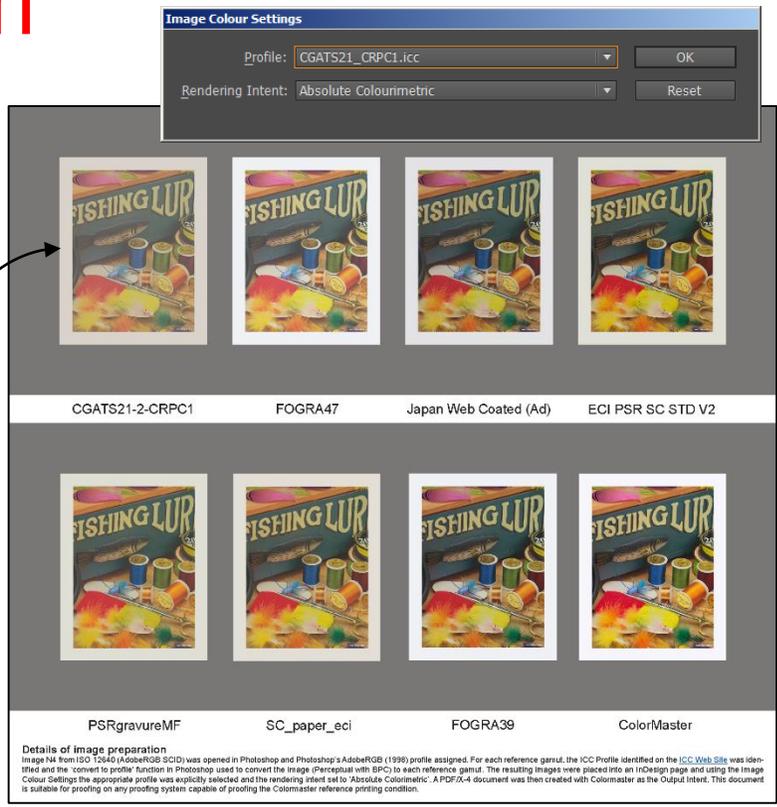
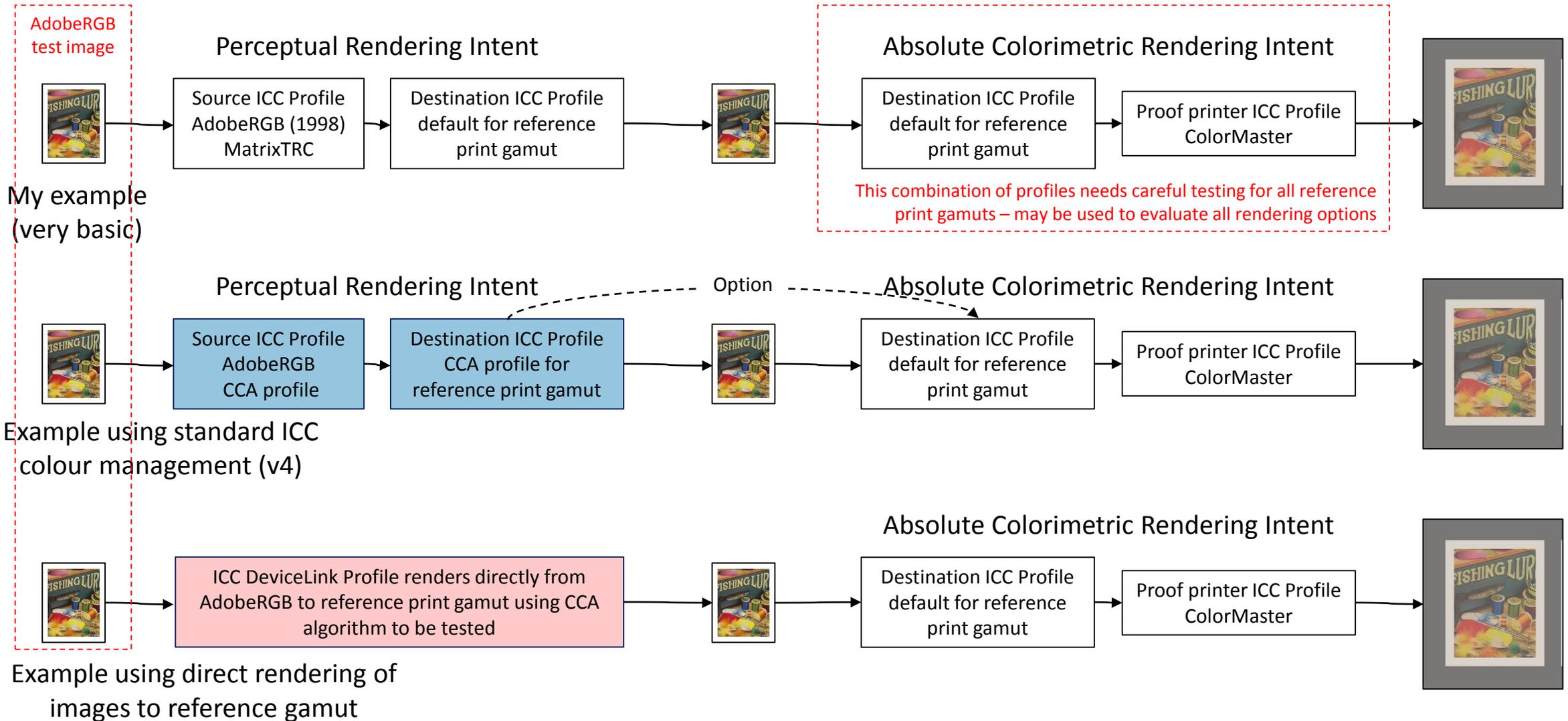


Image placed in InDesign document with the appropriate ICC Profile and 'Absolute Colorimetric' rendering intent explicitly selected for each image

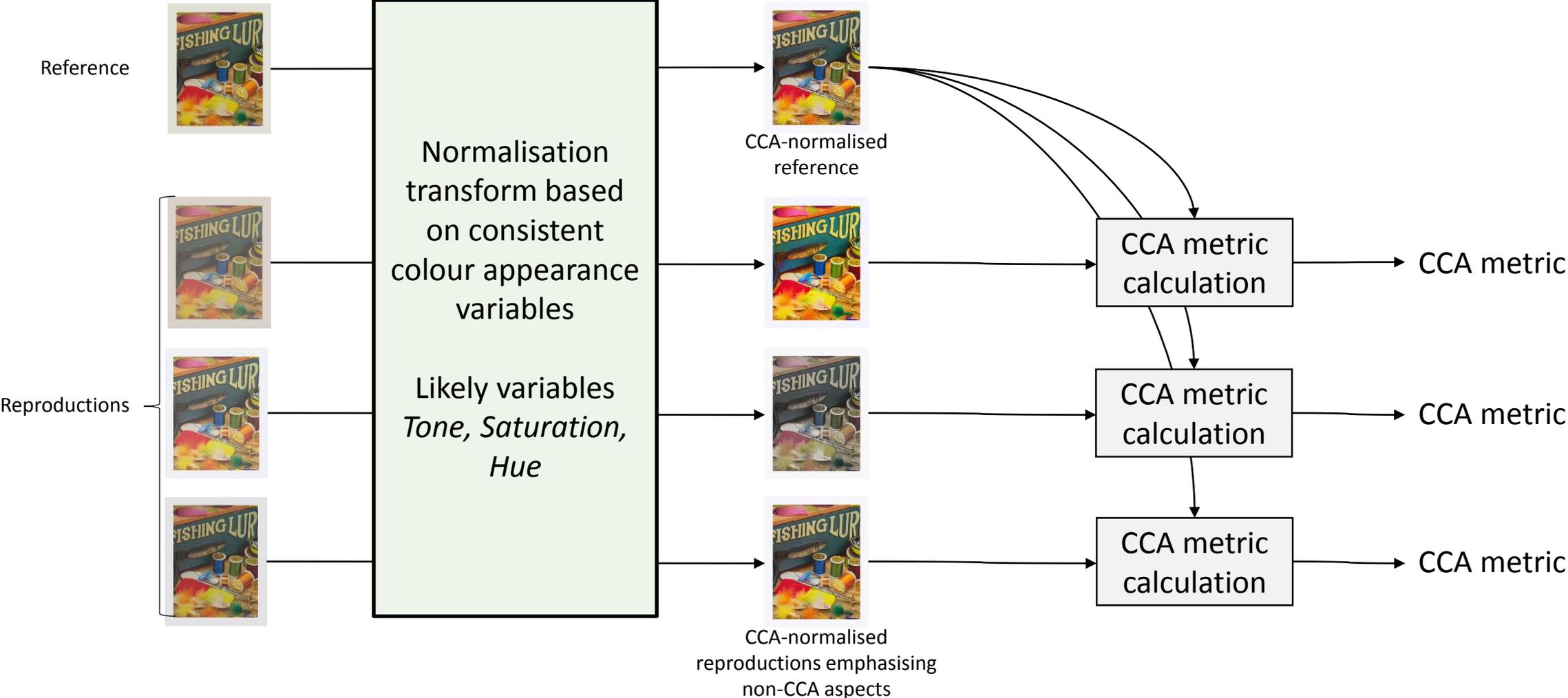
A PDF/X document was created which uses ColorMaster as its OutputIntent profile. This PDF document may be printed on any proofing system which is capable of proofing ColorMaster

ICC-based testing using more complex rendering algorithms



Metric development ideas

Possible approach to metric development (Max Derhak)



Discussion