

ICC Votable Proposal Submission

Colorimetric Intent Image State Tag Proposal

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Date: 16 June 2006

Proposal Version 1.2

1. Introduction:

The ICC v4 specification defines the perceptual rendering intent reference medium, and consequently the image state in the PCS resulting from perceptual intent transforms. However, the image state in the PCS resulting from the application of colorimetric intent transforms remains undefined. This is not an issue when the colorimetric rendering intents are used to produce colorimetric reproductions (with the built-in chromatic adaptation) using a static CMM, but is an incomplete specification when the colorimetric intent transforms are used to support dynamic CMM colour rendering and re-rendering.

Some application areas in digital photography and motion pictures require the option to objectively communicate the scene colorimetry or appearance photographed (or created synthetically), e.g. to allow it to be presented directly to the viewer, or to permit the client control of the colour rendering.

Historically this has been less of a problem, as most content represented in the PCS using the colorimetric rendering intent transforms has been picture-referred. Also, dynamic CMM colour rendering and re-rendering beyond simple black point compensation have not been widely available. However, there is rapidly growing interest in the use of ICC colour management to support scene-referred image data, and at least one major CMM provider has announced that they will support dynamic CMM gamut mapping, which could to some extent be used to perform colour rendering and re-rendering. It is likely that other CMM providers will follow with increased dynamic CMM capabilities.

Currently, there is no way to unambiguously communicate that the PCS colorimetry resulting from the colorimetric rendering intent transforms is scene-referred, appearance-referred, etc. Because of this, the large and rapidly growing number of users that need this capability will be forced to use a non-ICC solution or use the ICC in a non-standard way. Neither solution is good for the imaging industry or the ICC.

2. The acceptance of this proposal will result in:

A new extensible Colorimetric Intent Image State tag. The tag is type signature, and indicates the image state of the colorimetry represented in the PCS using the colorimetric rendering intent transforms (ICC-absolute and media-relative colorimetric).

Additionally, text will be added to the spec recommending that, in the absence of the Colorimetric Intent Image State tag, colorimetry represented in the PCS using the colorimetric rendering intents should be assumed to be picture-referred, with the media class as indicated in the profile header attributes.

This is a minor revision of the ICC specification. Static CMM behavior is not affected because a static CMM will simply apply the selected transforms.

3. Nature of the proposal:

This tag can help users or applications select the appropriate profile or rendering intent to use for a specified colour reproduction objective. It can also be used by a dynamic CMM to determine the most appropriate colour rendering or re-rendering algorithms to use. The ICC does not specify how to render or re-render amongst image states. This tag only informs a user or application of the image state produced using the colorimetric rendering intents contained in an ICC profile.

4. Votable proposal:

4. Add the following definitions:

adopted white

spectral radiance distribution as seen by an image capture or measurement device and converted to colour signals that are considered to be perfectly achromatic and to have an observer adaptive luminance factor of unity; i.e. colour signals that are considered to correspond to a perfect white diffuser

NOTE 1 The adopted white may vary within a scene.

NOTE 2 No assumptions should be made concerning the relation between the adapted or adopted white and measurements of near perfectly reflecting diffusers in a scene, because measurements of such diffusers will depend on the illumination and viewing geometry, and other elements in the scene that may affect perception. It is easy to arrange conditions for which a near perfectly reflecting diffuser will appear to be grey or coloured.

[ISO 22028-1]

colour rendering

mapping of image data representing the colour-space coordinates of the elements of a scene to output-referred image data representing the colour-space coordinates of the elements of a reproduction

NOTE Colour rendering generally consists of one or more of the following: compensating for differences in the input and output viewing conditions, tone scale and gamut mapping to map the scene colours onto the dynamic range and colour gamut of the reproduction, and applying preference adjustments.

[ISO 22028-1]

encoding maximum white

highest luminance achromatic colour that can be represented using a specified colour encoding

image state

attribute of a colour image encoding indicating the rendering state of the image data

[ISO 22028-1]

medium white point

neutral colour with the highest luminance that can be produced by an imaging medium in normal use, measured using the specified measurement geometry

[ISO 22028-1]

picture-referred image state

image state associated with image data that represents the colour-space coordinates of the elements of a hardcopy or softcopy image, encompassing both original-referred image data and output-referred image data

NOTE 1 When the phrase “picture-referred” is used as a qualifier to an object, it implies that the object is in a picture-referred image state. For example, picture-referred image data are image data in a picture-referred image state.

NOTE 2 Picture-referred image data will generally be colour-rendered for a specific real or virtual imaging medium and viewing condition.

NOTE 3 Picture-referred image data can include image data that do not originate from an original scene, such as text, line art, vector graphics and other forms of original artwork.

[ISO 22028-1]

scene

spectral radiances of a view of the natural world as measured from a specified vantage point in space and at a specified time

NOTE A scene may correspond to an actual view of the natural world or to a computer-generated virtual scene simulating such a view.

[ISO 22028-1]

6.1

Add note after third paragraph;

NOTE When present, the Colorimetric Intent Image State tag indicates the image state of the reproduction media-relative colorimetry.

6.2.1 Change the last paragraph to:

In transforms for the media-relative and ICC-absolute colorimetric intents, for input profiles the PCS values may represent a colour rendering of the actual original captured. Likewise for output profiles, the PCS values may be colour rendered by the output device to the actual medium. However, wherever ICC profiles are used, unless the colorimetric intent image state tag is present, the PCS values resulting from such transforms shall be interpreted as the colorimetry of the original and reproduction, regardless of whether such colorimetry is the actual colorimetry. If the Colorimetric Intent Image State tag is present, then the interpretation of the colorimetry of the resulting PCS values shall be according to the value recorded in that tag.

NOTE All PCS colorimetry is picture-referred unless the Colorimetric Intent Image State tag says otherwise

6.2.2 Change the NOTE to:

NOTE Transforms for the media-relative colorimetric intent represent media-relative measurements of the captured original (for input profiles), or media-relative colour reproductions produced by the output device (for output profiles) unless otherwise indicated in the Colorimetric Intent Image State Tag.

6.2.3 Change NOTE 1 to:

NOTE 1 Transforms for the ICC-absolute colorimetric intent represent measurements of the captured original relative to a hypothetical perfectly reflecting or transmitting diffuser (for input profiles), or colour reproductions produced by the output device relative to a hypothetical perfectly reflecting or transmitting diffuser (for output profiles), unless otherwise indicated in the in the colorimetric intent image state tag.

6.3.2 Add to the first sentence of second paragraph as follows:
For picture-referred colorimetry, the PCS ...

8.3.2 Add the following:

If the image state produced in the PCS using the ICC-absolute or media-relative colorimetric rendering intents is not picture-referred, the Colorimetric Intent Image State tag should be included. If the Colorimetric Intent Image State tag is not included, colorimetry represented in the PCS should be interpreted to be picture-referred, with the media class as indicated in the profile header attributes.

9.2.X Colorimetric Intent Image State

Tag signature: 'ciis' (63696973h)

Allowed tag type: signatureType

This tag indicates the image state of PCS colorimetry produced using the colorimetric intent transforms. If present, the Colorimetric Intent Image State tag shall specify one of the following ICC-defined image states. Other image state specifications are reserved for future ICC use.

NOTE When the state of the image colorimetry represented in the PCS is different from that of the image data in the file, the colorimetric intent image state includes the word "estimates". This will be the case when transformation of the image file data to colorimetry is not fully deterministic.

EXAMPLE If the spectral sensitivities of a digital camera sensor (or photographic film) are not a linear transform of the CIE XYZ colour matching functions, there will not be a single "correct" transform to focal plane colorimetry.

scene colorimetry estimates, signature:'scoe' (73636F65h)

colorimetry in the PCS represents estimates of the colorimetry of the scene, as viewed from the capture point, chromatically adapted from the scene adopted white chromaticity to the PCS D50 adopted white chromaticity. With the media-relative colorimetric intent, the colorimetry is relative to the scene encoding maximum white (after chromatic adaptation). With the ICC-absolute colorimetric intent, the colorimetry is relative to the scene adopted white (after chromatic adaptation). The scene colorimetry may result from a real scene, a synthetically generated scene, an edited scene, or some combination of these, but shall be interpreted as actual scene colorimetry for subsequent processing. When this image state is specified, the actual scene viewing conditions, including the adopted white, shall be specified in the viewing conditions tag.

For scene colorimetry estimates, the mediaWhitePointTag is populated with the XYZ tristimulus values of the scene encoding maximum white, normalized to be relative to the scene adopted white (perfect diffuser), and then converted to the corresponding tristimulus values for the D50 PCS white point using the chromaticAdaptationTag matrix (if required). The scene adopted white Y value is normalized to 1.0; the mediaWhitePointTag Y value is relative to the scene adopted white Y value and can be larger than 1.0.

NOTE 1 The un-normalized adopted white values are stored in the illuminant field in the viewing conditions tag.

NOTE 2 Since the media white point Y value may be larger than 1.0, brighter than diffuse white colors (e.g., specular highlights) can be represented.

scene appearance estimates, signature:'sape' (73617065h)

colorimetry in the PCS is corresponding colorimetry that represents estimates of the appearance of the scene, as viewed from the capture point, fully adapted to the ISO 3664 P2 viewing conditions. With the media relative colorimetric intent, the corresponding colorimetry is relative to the scene encoding maximum white (after adaptation). With the ICC-absolute colorimetric intent, the corresponding colorimetry is relative to the scene adopted white (after adaptation). The scene appearance estimates may result from a real scene, a synthetically generated scene, an edited scene, or some combination of these, but shall be interpreted as scene appearance estimates for an actual scene in subsequent processing. When this image state is specified, the ISO 3664 P2 viewing conditions shall be specified in the viewing conditions tag.

For scene appearance estimates, the mediaWhitePointTag is populated with the XYZ tristimulus values of the scene encoding maximum white, normalized to be relative to the scene adopted white (perfect diffuser), and then converted to the corresponding tristimulus values for the D50 PCS white point using the chromaticAdaptationTag matrix (if required). The scene adopted white Y value is normalized to 1.0; the

mediaWhitePointTag Y value is relative to the scene adopted white Y value and can be larger than 1.0.

NOTE Since the media white point Y value may be larger than 1.0, brighter than diffuse white colors can be represented (e.g., specular highlights).

focal plane colorimetry estimates, signature: 'fpce' (66706365h)

colorimetry in the PCS represents estimates of the colorimetry of the light present at the focal plane of a camera (digital or film), chromatically adapted from the focal plane adopted white chromaticity to the PCS D50 adopted white chromaticity. With the media relative colorimetric intent, the colorimetry is relative to the focal-plane encoding maximum white (after chromatic adaptation). With the ICC-absolute colorimetric intent, the colorimetry is relative to the focal plane adopted white (after chromatic adaptation). The focal plane colorimetry may result from a real scene, a synthetically generated scene, an edited scene, or some combination of these, but shall be interpreted as focal plane colorimetry for subsequent processing. When this colorimetric intent image state is specified, the actual focal plane viewing conditions, including the adopted white, shall be specified in the viewing conditions tag.

For focal plane colorimetry estimates, the mediaWhitePointTag is populated with the XYZ tristimulus values of the focal plane encoding maximum white, normalized to be relative to the focal plane adopted white (perfect diffuser), and then converted to the corresponding tristimulus values for the D50 PCS white point using the chromaticAdaptationTag matrix (if required). The focal plane adopted white Y value is normalized to 1.0; the mediaWhitePointTag Y value is relative to the focal plane adopted white Y value and can be larger than 1.0.

NOTE 1 The effects of any optics in or attached to the camera are included in the focal plane colorimetry estimates; this includes lens flare, filters, etc.

NOTE 2 The un-normalized adopted white values are stored in the illuminant field in the viewing conditions tag.

NOTE 3 Since the media white point Y value may be larger than 1.0, brighter than diffuse white colors can be represented (e.g., specular highlights).

reflection hardcopy original colorimetry, signature: 'rhoc' (72686F63h)

colorimetry in the PCS represents the colorimetry of a reflection hardcopy original that has been digitally scanned, and chromatically adapted from the scanner adopted white chromaticity to the PCS D50 adopted white chromaticity. With the media relative colorimetric intent, the colorimetry is normalized relative to the scan condition encoding maximum white after chromatic adaptation to D50. With the ICC-absolute colorimetric intent, the colorimetry is relative to the perfect reflecting diffuser after chromatic adaptation to D50. When this colorimetric intent image state is specified, the scan illumination conditions, including the adopted white, shall be specified in the viewing conditions tag and the chromatic adaptation shall be specified in the chromaticAdaptationTag.

NOTE The un-normalized adopted white values are stored in the illuminant field in the viewing conditions tag.

reflection print output colorimetry, signature: 'rpoc' (72706F63h)

colorimetry in the PCS represents the colorimetry of reflection print output, after chromatic adaptation from the print viewing condition adopted white chromaticity to the PCS D50 adopted white chromaticity. With the media relative colorimetric intent, the colorimetry is normalized relative to the print medium white point, measured under the actual print viewing conditions. With the ICC-absolute colorimetric intent, the colorimetry is relative to the perfect reflecting diffuser after chromatic adaptation to D50. When this colorimetric intent image state is specified, the print viewing conditions, including the adopted white, shall be specified in the viewing conditions tag, and the chromatic adaptation shall be specified in the chromaticAdaptationTag.

NOTE The un-normalized adopted white values are stored in the illuminant field in the viewing conditions tag.

9.2.25 Replace the paragraph with the following:

This tag is used for generating ICC-absolute colorimetric rendering intent transforms. It specifies the relative XYZ tristimulus values of the medium white point, recorded after chromatic adaptation to the D50 PCS white point. The medium white point is measured relative to a perfect diffuser (the perfect diffuser is normalized to a Y value of 1.0) illuminated by the actual illumination source. If the actual illumination source has a chromaticity other than D50, then the measured relative values are converted to the corresponding tristimulus values for the D50 PCS white point using the chromaticAdaptationTag matrix. The converted measured relative values are recorded in the mediaWhitePointTag. For capture devices, the medium white point is the encoding maximum white for the capture encoding. For displays, the values recorded in the mediaWhitePointTag shall have the same chromaticity as D50, normalized such that $Y = 1,0$ (i.e. 0,9642 1,0 0,8249).

5. Applications and Workflows:

Examples of assignment of profiles with Colorimetric Intent Image State tags:

- Camera saves raw camera RGB file with ICC profile.
- User saves raw camera RGB file with ICC profile incorporating user guided camera raw application processing to output-referred in perceptual intent.
- Application or user assigns appropriate ICC profile to file that contains other than picture-referred image data

Examples of use of Colorimetric Intent Image State tags:

- User requests colorimetric reproduction of scene. Application uses ICC-absolute colorimetric rendering intent of both source and destination profiles.
- User requests colorimetric interpretation of scene, but with scene adopted white mapped to reproduction medium white. Application uses ICC-absolute colorimetric intent of source profile and media relative colorimetric rendering intent of destination profile.
- User requests preferred reproduction of scene. Application uses perceptual rendering intent of both source and destination profiles.
- User requests to convert camera raw file to scene colorimetry in an output-referred working space for manually applied colour rendering. Application uses media-relative colorimetric intent of both source and destination profiles.

In the following cases, the scene-referred working space selected will need to have adequate headroom to contain all the image data, or clipping may occur.

- User requests to convert camera raw file to scene colorimetry in a scene-referred working space. Application uses ICC-absolute colorimetric rendering intent of both source and destination profiles.
- User requests to convert files with different scene-referred colour encodings to a common scene-referred working space. Application uses ICC-absolute colorimetric rendering intent of both source and destination profiles.