TECHNICAL REPORT

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Graphic technology and photography — Colour characterization of digital still cameras (DSCs) —

Part 3: User controls and readouts for scene-referred imaging applications

Technologie graphique et photographie — Caractérisation de la couleur des appareils photonumériques —

Partie 3: Contrôles utilisateur et lectures pour les applications d'imagerie par scène

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Foreword

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This document was prepared by Technical committee ISO/TC 42, *Photography*.

A list of all the parts in the ISO 17321 series can be found on the ISO website.

Introduction

Pictorial photography by and large produces images that convey the specific artistic intent of the photographer. The intent might convey a complex artistic vision, or it might simply attempt to create images that are generally pleasing to viewers. Other types of photography, such as the reproduction of images of artworks and other objects for archival purposes and the reproduction of images for scientific measurement and analysis, reproduce images that require an accurate representation of the scene captured, where accuracy is measured in terms of relative colourimetry or adapted relative colourimetry (for cases where viewer adaptation differs when looking at the correctly reproduced image and when looking at the actual scene).

Images for pictorial photography are typically processed with an *output-referred representation* on some medium. In the case of film, the medium is often a photographic print or transparency. In the case of digital capture, the output characteristics are specified and communicated either by the identification of a standard reference medium, such as sRGB or ROMM RGB, or by the inclusion of an output-intent ICC profile.

Output-referred images are often not colourimetrically accurate photographic reproductions of the actual scene or object because

— scenes vary widely in their highlight-to-midtone and midtone-to-shadow luminance rations, in their colour gamuts, and in other characteristics,

— output media vary widely in their colour gamuts and their luminance range capabilities, and

— pictorial photographers choose output media whose characteristics complement their artistic intent.

While *scene-referred (SR) images*, that is, colourimetrically accurate images of scenes and objects, are required, it is difficult to obtain colourimetrically accurate images of scenes and objects.

Digital archiving facilities sometimes use targets to create ICC profiles to invert the colour processing from output-referred images to scene-referred images. This approach is commonly used, but it has significant drawbacks:

a) characterization charts do not always represent the actual spectra to be captured;

b) the camera colour processing and chart used can limit the colour gamut and dynamic range of the resulting scene-referred images;

c) precise exposure control is difficult because the camera and image readouts typically reflect the state of the image prior to application of the ICC profile;

d) some cameras employ colour processing that is image dependent when producing output-referred images.

In this last case the ICC profile determined with the chart is only likely to be accurate when photographing the chart itself.

It is also possible to obtain scene-referred images by converting camera raw images using camera raw processing software. This approach is technically more sound than creating scene-referred images from output-referred images, but there are still issues:

— commercial camera raw processing tends to be focused on creating output-referred images;

— open-source software tends to be complex;

— additional software is often needed to convert the scene-referred image data to standard scene-referred colour encodings.

Users need simple and clear camera and camera raw processing controls and readouts that allow them to easily produce quality scene-referred images in appropriate encodings.

This document describes a scene-referred (SR) capture-processing mode that could be added to digital still cameras for use by those photographers interested in colourimetrically accurate images of scenes and objects.

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Part 3:
User controls and readouts for scene-referred imaging applications

1 Scope

This document provides guidelines for user controls and readouts employed in scene-referred capture processing modes implemented in digital cameras and camera raw processing software.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at http://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

4 Design of scene-referred (SR) capture processing mode

4.1 General

The SR capture processing mode is intended for applications where the objective is to produce images that represent colourimetrically accurate colours of the scene captured. When using the SR mode it is best if the capture conditions such as the scene illumination geometry and spectral characteristics of the illumination are controlled by the user, such as in a studio or reprographic setup. The SR mode is not specifically intended for general pictorial photography. See Annex A for additional information.

4.2 Processing aims

The aim of the colour processing applied is to produce accurate scene colourimetry, with the scene adopted white adapted to the image encoding adopted white as described in ISO/TR 17321-2. ISO 17321-1 specifies camera characterization metrology. ISO/TR 17321-2 provides considerations for determining scene analysis transforms.

4.3 Colour encoding and file format

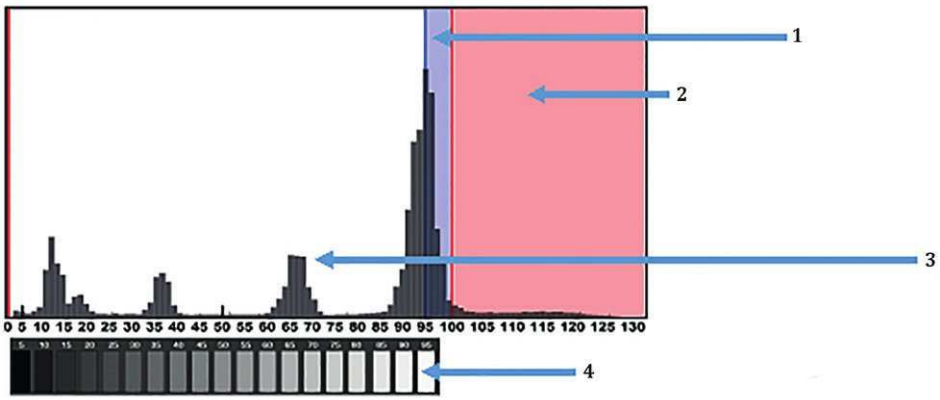
In the SR capture processing mode, the colour encoding used for the images is a scene-referred encoding, such as the scRGB colour encoding specified in IEC 61966-2-2, or the RIMM RGB encoding specified in ISO/TS 22028-3. It is important that most colours of interest in the scene are within the colour gamut and dynamic range of the encoding selected. The encoding selected is communicated by the file format used, for example by embedding an ICC profile.

4.4 User readouts

A CIE L^* (L^*) histogram of the image is presented to the user, that is, the scene-referred image values are converted to L^* values and displayed in the histogram. L^* values are displayed from "0" to "over 100". Preferably, main markers are placed at L^* = 0, 50 and 100, with sub markers at every L^* = 5 values (see Figure 1).

It is also useful to display image values above diffuse white, extending L^* values above L^* = 100 based on the colour encoding and file format used (see Figure 1).

NOTE Values over L^* = 100 are utilized in this document, but it does not address the degree to which L^* is perceptually uniform.



Key

1 diffuse white threshold-(L^*=95)
2 headroom-(based on encoding headroom)
3 histogram display
4 scene adopted white chromaticity reference (L^*=95)

Figure 1 — Example of histogram frame

4.5 Indication of SR mode

It is desired that the SR mode is clearly indicated by words such as "scene-referred" or "SR" on the appropriate camera mode control, in the camera menu, or in the camera raw processing software user interface. It is important that the user be aware when they are in a scene-referred mode and when they are not.

4.6 Guideline for raw processor

In the SR mode, the raw processor converts raw files to scene referred image files. The colour rendering is disabled and scene-referred encodings as defined in ISO 22028-1 are used for the processed images. The raw processor offers the option to use recorded scene adopted white (exposure and white balance) information.

Annex A
(informative)

Guidelines for capture using scene-referred (SR) capture processing mode

A.1 Guideline for proper illumination of artwork reproduction/archives

The proper illumination for two-dimensional artwork is the uniform illumination produced by light sources placed at an angle of incidence of 30° to 45°. Lens flare can negatively impact image quality. Use of a lens shade and minimizing unwanted light reflection in the scene is helpful.

NOTE 1 If the imaging system incorporates lens fall-off corrections or flat fielding these corrections can be applied to improve image uniformity.

NOTE 2 The light sources used for capture are supported by the camera or camera raw processing software. In other words, the camera or camera raw processing software produces colourimetrically accurate scene-referred images with the light sources used. For this to happen, it is important to consider the spectral power distribution of the light sources.

A.2 Guideline for setting the white balance

It is desirable that users have the ability to set the white balance. The following two approaches are used:

— Method 1: use of a full frame reference target to set the white balance (custom white balance).

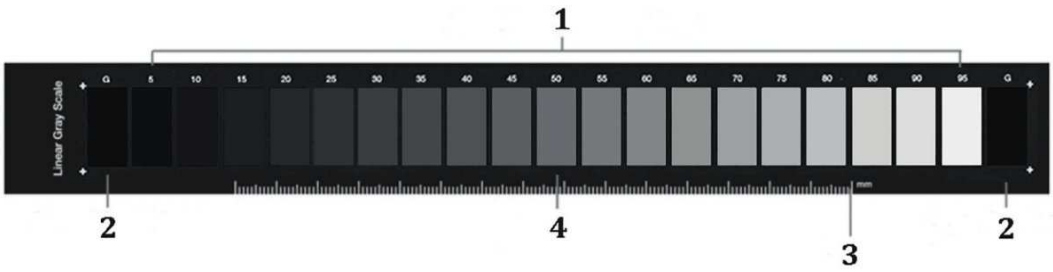
— Method 2: use of a user selection tool to define a specific region in an image preview to be used for setting the-white balance (custom white reference - can be used in conjunction with the same target used for exposure described in A.3).

Typically, the specific circumstances determine which of the above methods are preferred.

A.3 Guideline for proper exposure setting

Exposure is set using a reflective chart comprised of equally spaced in L^*, spectrally neutral semi-gloss and additional (optional) gloss black patches (see Figure A.1), and comparing the known chart patch L^* values to direct readout of captured scene L^* values. The camera is adjusted so that the $L^* = 95$ white patch produces a scene-referred image value of $L^* = 95$, this step also being used to set the white balance.

In some cases it is desirable to set the exposure based on the midtone $L^* = 50$ patch, as many cameras and exposure metres are designed to set exposure based on a midtone.



Key

1 semi-gloss values (L^*= 5 to L^*= 95)

2 gloss black (L^*=4)

3 measurement scale, in millimetres

4 perceptual middle value (L^*=50)

Figure A.1 — Illustration of reflective chart used for exposure setting

NOTE 1 This figure is uncalibrated and printed versions will typically not be suitable to be used for exposure setting without first calibrating them.

NOTE 2 Additional targets such as a specular surface or a black light trap can be utilized to evaluate above diffuse white values or black levels.

NOTE 3 It is not advisable to use patches darker than CIE L^* = 50 to set exposure, as the precision with which the exposure is set is reduced as the patch used gets darker.

NOTE 4 An incident light meter can be used as long as it has been calibrated to the imaging system's chart based (reflective) actual response.

A.4 Guideline for white balance and exposure validation

In a properly exposed and white balanced capture of a reflective chart used for setting exposure (described in A.3 and illustrated in Figure A.1), the scene referred image values from L^* = 5 to L^* = 95 will ideally be equal to the chart values.

NOTE ISO/TS 19264-1 provides practical guidance for artwork reproduction.

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