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ISO TC 42~~/WG 23~~

Date: 2023-~~02-09~~XX

Secretariat: ANSI

Photography and graphic technology — Extended colour encodings for digital image storage, manipulation and interchange — Part 5: High Dynamic Range and Wide Colour Gamut encoding for still images (HDR/WCG)

Photographie et technologie graphique — Codages par couleurs étendues pour stockage, manipulation et échange d'image numérique — Partie 5: Plage dynamique élevée et codage large de la gamme de couleurs pour les images fixes (HDR/WCG)

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

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A list of all parts in the ISO 22028 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

This ~~part 5 of ISO 22028~~document has been developed to meet the industry need for a complete, fully documented, publicly available specification of high dynamic range (HDR) and wide colour gamut (WCG) image encodings for digital still images.

High dynamic range images, that have been produced to look correct on high dynamic range displays, can provide a better user experience than standard dynamic range images. High dynamic range images allow a greater range of shadow and highlight detail to be conveyed, with sufficient precision and acceptable artifacts, including sufficient separation of diffuse white and specular highlights.

Wide colour gamut images, in addition, can represent a wider range of colours and allow for better colour reproduction. These two features are commonly bundled together. In this document, for simplicity, we will refer to both such features using the HDR/WCG acronym.

ITU-R has published requirements and guidelines for HDR/WCG television production and exchange, the foundation of the blooming HDR/WCG video and movie ecosystems. There are now a growing number of HDR/WCG displays (Smartphones, TVs, computer displays) that consumers use in their daily life, but a limited amount of HDR/WCG still image content is available.

In parallel, digital cameras improve over time and capture more and more dynamic range. To overcome the limitations of sensing technology, HDR images can be generated by fusing several images captured with different exposures. But so far, the digital still imaging industry has not settled on a reference HDR/WCG image encoding for consumers.

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The purpose of this document is to provide requirements and guidelines for colour encoding of HDR/WCG still images. The digital still imaging industry will benefit from these requirements and guidelines. They will help establish a standard and open HDR/WCG ecosystem, to take better advantage of HDR cameras and displays. These colour encoding requirements and guidelines can be leveraged in the specification of HDR/WCG file formats.

The encoding and decoding methods specified in this document are from ITU-R BT.2100-2, to ensure full compatibility with existing HDR/WCG devices and the associated video and movie ecosystems. Metadata is specified in this document to support the communication of scene-referred and display-referred image states in accordance with ISO 22028-1.

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The outline of this document is as follows. The scope is defined in ~~clause~~Clause 1, the normative references are listed in ~~clause~~Clause 2. Clause 3 lists the terms, definitions, and acronyms. Clause 4 covers the colour image encoding requirements.

Annex A (normative) specifies the extended HDR/WCG colour encoding.

Annex B (informative) lists a selection of highly relevant ITU-R Rec. BT.2100-2 tables.

Annex C (informative) lists relevant ISO/IEC 23000-22 ~~AMD2~~/Amd.2 tables, that are related to metadata recommended in this document.

Annex D (informative) presents different HDR workflows.

Annex E (informative) provides information about ISO 22028-1 image states and the linear light interpretations of HDR image signal values specified in ITU-R BT.2100-2.

Annex F (informative) presents tone mapping options.

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Photography and graphic technology — Extended colour encodings for digital image storage, manipulation and interchange — Part 5: High Dynamic Range and Wide Colour Gamut encoding for still images (HDR/WCG)

1 Scope

This part 5 of ISO 22028document defines a set of colour image encodings for use in storage, transmission, and display of high dynamic range and wide colour gamut (HDR/WCG) digital still images. It defines the colour encodings, the mandatory and optional metadata, and the reference viewing conditions for HDR/WCG images.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

<std>ISO 22028-1:2016, *Photography and graphic technology — Extended colour encodings for digital image storage, manipulation and interchange — Part 1: Architecture and requirements*</std>

<std>ISO/IEC 23000-22:2019/AMD 2, *Information technology — Multimedia application format (MPEG-A) — Part 22: Multi-image application format (MIAF) — Amendment 2: HEVC Advanced HDR profile and other clarifications*</std>

<std>ISO/IEC 23008-2:2020, *Information technology — High efficiency coding and media delivery in heterogeneous environments — Part 2: High efficiency video coding*</std>

<std>ISO/IEC/TR 23091-2:2021, *ITU-T H.273, Information technology — Coding-independent code points — Part 2: Video*</std>

<std>ISO/IEC 23091-2:2021/ITU-T H.273, *Information technology — Coding-independent code points — Part 2: Video*

ISO/IEC/TR 23091-4:2021 / ITU-T H SUPPLEMENT 19, *Information technology — Coding-independent code points — Part 4: Usage of video signal type code points*</std>

<unknown>Recommendation ITU-R BT.2100-2 (07/2018): *Image parameter values for high dynamic range television for use in production and international programme exchange*</unknown>

<std>SMPTE ST 2086:2018 *SMPTE Standard – Mastering Display Color Volume Metadata Supporting High Luminance and Wide Color Gamut Images*</std>

<std>SMPTE ST 2113:2018 *SMPTE Standard – Colorimetry of P3 Color Spaces*</std>

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3 Terms, definitions and acronyms

For the purposes of this document, the following terms and definitions apply.

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

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

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

3.1
coding-independent code points for video signal type identification
CICP
metadata that describes the colour image characteristics of the associated picture

~~[SOURCE: ISO/IEC 23091-2:2021/ITU-T H.273]~~

3.2
colour image encoding
digital encoding of the colour values for a digital image, including the specification of a colour space encoding, together with any information necessary to properly interpret the colour values such as the image state, the intended image viewing environment, and the reference medium

[SOURCE: ISO 22028-1~~:~~:2016, 3.9, modified — Notes to entry were deleted.]

3.3
colour volume
space of all colours and intensities that a device or signal can reproduce or convey

[SOURCE: ISO/IEC TR 23091-4:2021~~:~~, 3.6/ITU-T H.SUPPLEMENT 19]

3.4
content colour volume
CCV
metadata that describes the colour volume (colour primaries, white point, and luminance range) characteristics of the associated picture

~~[SOURCE: ISO/IEC 23008-2]~~

3.5
content light level
CLL
metadata that describes the light level characteristics (maximum and average) of the associated picture

~~[SOURCE: ISO/IEC 23000-22]~~

3.6
diffuse white
stimulus that an observer adapted to the displayed content in the viewing environment would judge to be neutral and to have a luminance factor of unity

3.7
display light
image values that result from applying the reference EOTF to the encoded image signal values

3.8

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display viewing colorimetry
colorimetry appropriate for a targeted display with specified viewing conditions

Note 1 to entry: The display viewing colorimetry typically depends on the creative intent for the content.

3.9
display referred
image state associated with image data that represents the colour-space coordinates of the elements of an image that has undergone colour-rendering appropriate for a specified display and viewing conditions

3.10
~~electro~~electrical-electrical transfer function
EETF
transfer function that adjusts the electronic signal, e.g. to tone map it to a lower display range

3.11
electro-optical transfer function
EOTF
transfer function which converts the non-linear signal into display light

3.12
high dynamic range and wide colour gamut encoding
HDR/WCG encoding
Colour image encoding that can contain wider variations in brightness, with a dynamic range significantly higher than that of a standard dynamic range encoding, and a wider range of colours with more saturated colours than standard colour gamut encodings

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3.13
high dynamic range image
HDR image
image that contains wider variations in brightness, with a dynamic range significantly higher than that of a standard dynamic range image

3.14
highlights
image pixels with colorimetric values higher than those of the reference diffuse white

3.15
image
data structure that contains pixels and image-related data

[SOURCE: ISO/IEC 12087-1:1995, 3.1.3]

3.16
mastering display
a display that is used or targeted for viewing while authoring the content

3.17
mastering display colour volume
MDCV
metadata that identifies the colour volume (the colour primaries, white point chromaticity, and luminance range) of a mastering display

[SOURCE: SMPTE ST 2086:2018]

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3.18
nominal peak luminance
luminance resulting on a display from the specified encoding peak white signal level

Note 1 to entry: The peak white signal level is specified to be lower than the peak signal level for narrow range encodings.

3.19
nominal diffuse white luminance
display luminance a viewer would consider, on average, correspond to a perfectly reflecting diffuser in the scene when viewing the mastering display

3.20
opto-~~electrical~~electronic transfer function
OETF
transfer function that converts scene light into non-linear signal values

3.21
opto-optical transfer function
OOTF
transfer function that converts scene light to display light

3.22
~~reference~~nominal diffuse white
diffuse white value typical for the content encoding that is assumed for general purposes, independent of specified content or other information about the actual diffuse white

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3.23
scene light
image values that result from applying the inverse reference OETF to the encoded image signal values

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3.24
transfer function
single variable, monotonic mathematical function applied individually to one or more colour channels

3.25
wide colour gamut
WCG
gamut that has saturated colour primaries and includes a broad range of saturated colours

Note 1 to entry: It is wider than a standard colour gamut such as sRGB.

Note 2 to entry: WCG encodings provide a means to encode images with more saturated colours than standard colour gamut encodings, to represent a wider range of colours and allow for better colour reproduction.

4 Requirements

4.1 General introduction

The colour image encodings specified in this document conform to the requirements defined in ISO 22028-1:2016, Clause 5, and include a colour space representation, associated metadata, a reference viewing environment, and a reference medium.

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