TECHNICAL REPORT

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

Part 5: Colour targets including saturated colours for colour characteristic evaluation test for colorimetric image capture

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

Partie 5: Cibles de couleurs incluant des couleurs saturées pour l'essai d'évaluation des caractéristiques chromatiques pour la capture d'images en mode colorimétrique

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

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

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

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Introduction

There are many application areas such as medical imaging, cosmetics, e-commerce, sales catalogue, fine art reproduction, art archive etc. where colorimetric image capture and colorimetric image reproduction are desired. When precise colorimetric reproduction is required for the subjects that include highly-saturated colours, it is desirable that overall sensor spectral sensitivities are close to linear combinations of CIE 1931 colour matching functions.

On the other hand, real DSCs have overall sensor spectral sensitivities that deviates from linear combination of CIE 1931 colour matching functions, and yet reproduces reasonable colours for general low-saturated colour objects. This is because most of spectral distribution of real-existing objects are well self-correlated in the wavelength direction. This is also true for the frequently-used colour target such as X-rite colour checker classic.

Therefore, when the precise colour reproduction is required for highly-saturated colour objects, it is important to use spectral distribution that are less self-correlated in the wavelength direction, for the evaluation of overall sensor spectral sensitivities.

For this purpose, Clause 3 proposes two methods for generating highly-saturated colour targets. The first method is statistical extension of existing objects spectra, and the second one is selection from artificial (LED-based) spectra.

Clause 4 then describes how these highly-saturated colour targets can be used for goodness evaluation of overall sensor spectral sensitivities. Applicability of several existing evaluation metrics (such as Vora's μ-factor and Sharma's FOM) are compared, using highly-saturated targets generated by the methods proposed in Clause 4.

Annex B gives details on colour gamut of boundary colour and Annex F gives more information on colour differences of patches of CDSW target.

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

Part 5:
Colour targets including saturated colours for colour characteristic evaluation test for colorimetric image capture

1 Scope

This document describes sample methods to generate spectra for colour targets comprised of highly saturated colours for colour characteristic evaluation of colorimetric image capture capability of digital still cameras (DSCs).

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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 http://www.electropedia.org/

3.1
colour-difference-sensitive wavelength
CDSW
wavelength sensitive to colour difference

3.2
colour matching functions
tristimulus values of monochromatic stimuli of equal radiant power

[SOURCE: CIE Publication 17.4, 845-03-23]

3.3
digital still camera
DSC
device which incorporates an image sensor and produces a digital signal representing a still picture

[SOURCE: ISO 12232:2012, 3.40, modified — Notes 1 and 2 to entry have been deleted.]

3.4
light-emitting diode
LED
semiconductor diode that emits non coherent optical radiation through stimulated emission resulting from the recombination of electrons and photons, when excited by an electric current

[SOURCE: IEC 60050-521, 521-04-39]

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3.5
overall sensor spectral sensitivities
OSSS
spectral sensitivities of overall sensor components, which could be derived as spectral sensitivities' product of optical elements (including IR/UV-cut filter), colour filter sets, and image sensor

3.6
tristimulus values
amounts of the three reference colour stimuli, in a given trichromatic system, required to match the colour of the stimulus considered. *(see colour matching functions)*

[SOURCE: CIE Publication 17.4, 845-03-22]

4 Highly-saturated colour targets

4.1 General

This document proposes two different methods for generating highly-saturated colour targets.

First one is "Extension of real existing spectra using an eigenvector method". Naturally existing saturated colour spectra are usually very difficult to obtain by measurement. Therefore, computed spectra are extended from the eigenvectors generated from spectral databases.

Second one is "Artificial (LED-based) spectra whose wavelength peak is on colour-difference-sensitive wavelength (CDSW)". Mathematical analysis was performed to select the wavelengths which were colour-difference-sensitive. Artificial (LED-based) spectra were then generated whose peak matches colour-difference-sensitive wavelength (CDSW).

4.2 Extension of real existing spectra using eigenvector method

4.2.1 General

The eigenvector-based procedure for generating highly-saturated colour targets is as follows:

— selection of spectral database (see 4.2.2);

— spectral reconstruction from the eigenvectors (see 4.2.3);

— calculation of boundary colours (see 4.2.3.2);

— calculation of saturated-colours using reference spectral distribution (see 4.2.3.3).

4.2.2 Selection of spectra database

The wavelength range and wavelength increment are user-definable. ISO 17321-1[7] described that the wavelength range is 380 nm to 730 nm with a sampling interval of 10 nm or less. The spectral distribution set selected depends on user's application.

The brightness level of the spectral distribution selected can be ignored because the brightness level is tuneable by scaling the eigenvectors used for spectral distribution reconstruction. Hue angle of the selected spectral distribution is very important and the use of evenly-spaced hue angle is recommended.

An example of the eigenvector sets (E_{ij}) is calculated on the selected spectral distribution set (described in Annex A).

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