TECHNICAL SPECIFICATION

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Photography — Digital cameras — Texture reproduction measurements —

Part 1: Frequency characteristics measurements using cyclic pattern

Photographie — Caméras numériques — Mesurages de la reproduction de la texture —

Partie 1: Mesurages des caractéristiques de fréquence en utlisant un modèle cyclique

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Contents

Page

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 on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 42, *Photography*.

Introduction

Texture generally means the visual and tactile surface quality derived from the physicality of the material and the roughness or graininess of the surface. For digital still cameras, texture is of course the visual surface quality and the characteristic of texture reproduction in the captured image is interpreted into the reproduction of the low contrast fine details. This Technical Specification specifies the measurement of how cameras reproduce texture defined as low contrast fine details.

The tendency to utilize small sensors with high pixel counts in some cameras leaves a very small amount of light reaching the individual pixel. With the signal getting smaller and the noise level remaining at a certain level, it is necessary to reduce the noise in the image processing after capturing the image. Although the algorithms used for noise reduction have been developed over time, they are still not able to differentiate texture in the actual scene from the unwanted noise introduced by the capturing system. This decreases the image quality and it is therefore helpful to have a method to measure the loss of texture. Texture can also be enhanced to increase the acutance of the image. The texture reproduction is dependent on frequency and contrast because the noise reduction and the acutance enhancement, etc. are nonlinearly dependent on the pixel value and the difference among the surrounding pixels.

This part of ISO 19567 specifies methods to measure texture reproduction using test charts with cyclic patterns. The test charts are based on the established measurement methods, multiburst (IEC 61146-1) and siemens star (ISO 12233). This part of ISO 19567 newly defines the density of the test charts and exposure setting of measured cameras. The measurement results are presented in the spatial frequency response (SFR) curves.

If one SFR is larger than the other in all frequency range, larger amount of texture is reproduced in the corresponding image. If two SFRs have a cross point and the larger SFR depends on the frequency range, the superior image in the subjective evaluation is dependent on the dominant frequency of the image. Comparison of the measurement result provides important information in the texture comparison of the captured images.

Texture in a real scene consists mostly of non-structured or random patterns as shown in Annex A. Although it has been confirmed by experiments (Annex C and Annex D) that the texture reproduction characteristics of most cameras are well represented by the measurements in this Technical Specification, some cameras are found to indicate different characteristics for structured patterns compared to those for non-structured patterns. Measurement methods using non-structured or random patterns are under study and are expected to be included in consequent parts to this Technical Specification.

Photography — Digital cameras — Texture reproduction measurements —

Part 1:
Frequency characteristics measurements using cyclic pattern

1 Scope

This part of ISO 19567 specifies a protocol to measure the texture reproduction in the images captured and processed by digital cameras including cameras in other devices, e.g. in camera phones.

This part of ISO 19567 specifies protocols for the measurement of the texture reproduction using test charts with cyclic pattern.

This part of ISO 19567 excludes the acceptable range of value for texture reproduction.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61966-2-1:1999, *Multimedia systems and equipment — Colour measurement and management — Part 2-1: Colour management — Default RGB colour space —sRGB*

IEC 61966-2-1/Amd 1:2003, *Multimedia systems and equipment — Colour measurement and management — Part 2-1: Colour management — Default RGB colour space —sRGB*

3 Terms and definitions

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

3.1
texture
low contrast fine details, which appear in objects

EXAMPLE Low contrast fine details, which is visible in *foliage, fur, sand, textiles, grass, or masonry surfaces*.

3.2
texture reproduction
response in the output image of cameras to the texture of the object in the scene

4 Test conditions

4.1 General

The following measurement conditions should be used as nominal conditions when measuring the texture reproduction of a digital camera.

4.2 Environments for measurement

The measurement shall be carried out in the following environment unless otherwise stated:

— Temperature: 23 °C ± 3 °C

4.3 Apparatus and hardware

Either a reflective chart or a transmissive chart may be used. The light flux from the target shall be diffused and shall not include any specular component.

4.4 Arrangement of measuring equipment

4.4.1 Reflective test chart

The arrangement of the measuring equipment for a reflective test chart shall be set up as shown in Figure 1. The camera shall be positioned so that it casts no shadow on the chart. The lamps shall be positioned at an angle which avoids direct specular reflection from the test chart entering the camera.

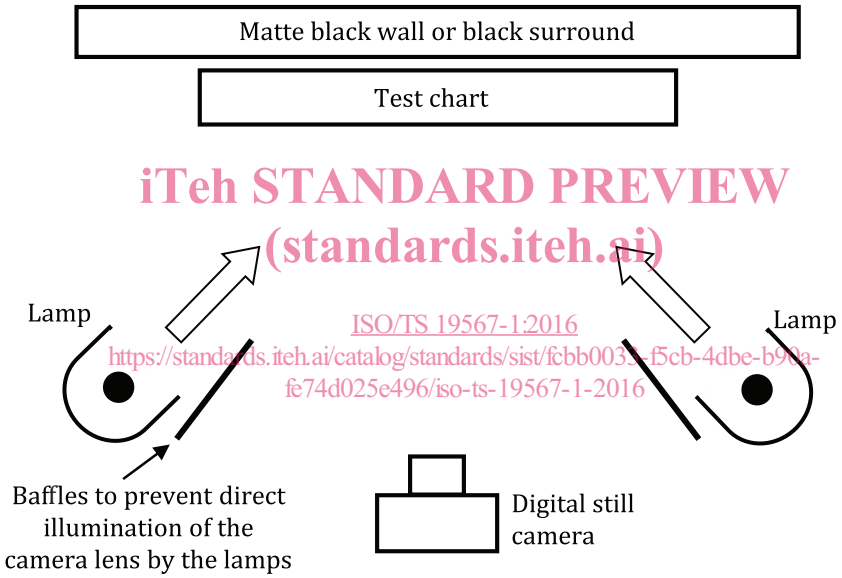

Figure 1 — Arrangement of measuring equipment for reflective test chart

4.4.2 Transmissive test chart

The arrangement of the measuring equipment for a transmissive test chart shall be set up as shown in Figure 2.

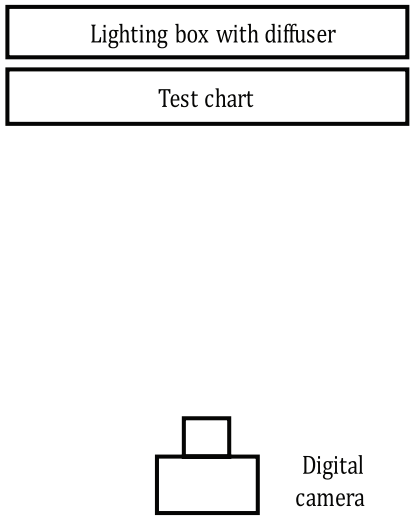

Figure 2 — Arrangement of measuring equipment for transmissive test chart

4.5 Lighting

Colour temperature of illumination shall be 5 700 K ± 1 000 K. Any illuminance level of the test chart may be applied for the texture reproduction measurement; however, the illuminance level in the range from 1 000 lx to 2 000 lx (in the case of transmissive chart, from 57,3 cd/m2 to 115 cd/m2 for 18 % gray) is recommended when the measurement has no specified purpose (e.g. low light performance). Non-uniformity of illumination on the chart shall be less than 10 %. The light source(s) should be positioned to provide uniform illumination and produce no glare or specular reflections from the target. A flickering light source is not recommended as it may cause banding artefacts to occur in the captured image. In the case of using a flickering light source, although it is not recommended, the exposure time shall not be shorter than one period of the flickering to minimize the banding artefacts caused by the light source.

4.6 Camera settings

The exposure should be adjusted to give the output value for the background gray near the centre of the measured chart to be the value corresponding to the input value defined below in the camera's output colour space.

(input luminance for gray) = (max input luminance) × (gray reflectance)

For sRGB cameras, the output Y for 18 % gray is 118 (8-bit).

The deviation of the exposure should be between +5 % and −10 % of the aforementioned target exposure. For example, the mean output luminance Y value for the 18 % gray should be 118 (8-bit) +2, −6 when the output colour space of the camera is sRGB 8-bit (IEC 61966-2-1 and IEC 61966-2-1/Amd 1).

The exposure shall be in the range of the aforementioned deviation when the measurement results of multiple cameras are compared (Annex B explains the basic concept for this stipulation). The exposure may be adjusted by the exposure bias setting of the camera or by adding a white or black card to the test chart.

White balance should be adjusted to render the centre of the image, as neutral as possible.

The focusing shall be in the best practically attainable focus.

For a camera with user selectable compression ratio (e.g. JPEG), the compression ratio should be minimum to minimize the artefacts of compression. The texture reproduction for RAW format image

data should be measured for the output of the RAW converter software. The name and the setting of the RAW converter shall be reported with the results of the measurement.

Other settings, such as “sharpness”, “noise reduction”, shall be in the default mode (factory shipping condition) if those settings are not reported.

5 Texture reproduction measurement procedure

5.1 General

Texture reproduction is measured by the amplitude of a sine waveform in this part of ISO 19567. The frequency characteristics of the texture reproduction are measured for various frequencies in the sine chart to be captured.

Two measurement methods, the multiburst and siemens star, are defined in this part of ISO 19567. The multiburst chart consists of several low contrast sine waves of discrete frequency (see Figure 3). Each sine wave consists of multiple cyclic patterns along a single direction in the multiburst chart. The siemens star chart consists of a low contrast sine wave-modulated star burst pattern (see Figure 4), which includes continuous frequency variation in all directions. Based on the structure of each chart, the multiburst and the siemens star can be used in the cases shown in Table 1.

Table 1 — Guidance for selecting the measurement

	Multiburst		Siemens star
(1)	In the case of measuring SFR with verification of the waveform and the amplitude of the captured image. (1–1) In the case when skilled engineer recognizes the SFR approximately from the waveform of the captured image of the multiburst and verifies that the measured SFR matches the recognized outline. (1–2) In the case of measuring SFR and the waveform simultaneously to see the transient response such as overshooting and undershooting.	(1)	In the case of measuring SFR by simply applying the software to the captured image.
(2)	In the case of measuring SFR with high precision along a single direction for a discrete frequency. The result of multiburst has higher precision especially for lower frequency than siemens star by averaging the pixel value in the direction perpendicular to the measurement direction and by averaging the amplitude of multiple cycles of the equal frequency along the measurement direction. The alignment of the chart and the width of averaging shall be adjusted to avoid miscalculation especially for higher frequency.	(2)	In the case of measuring SFR along multiple directions for continuous frequencies.
(3)	In the case of using software generally applied for measuring and displaying the digital value and the waveform of the image. For multiburst, it is easier to measure the amplitude for a certain frequency using such software because it consists of multiple cycles at the same frequency.	(3)	In the case of using software specially designed for the measurement of the texture reproduction.

5.2 Multiburst measurement

5.2.1 Low contrast multiburst chart

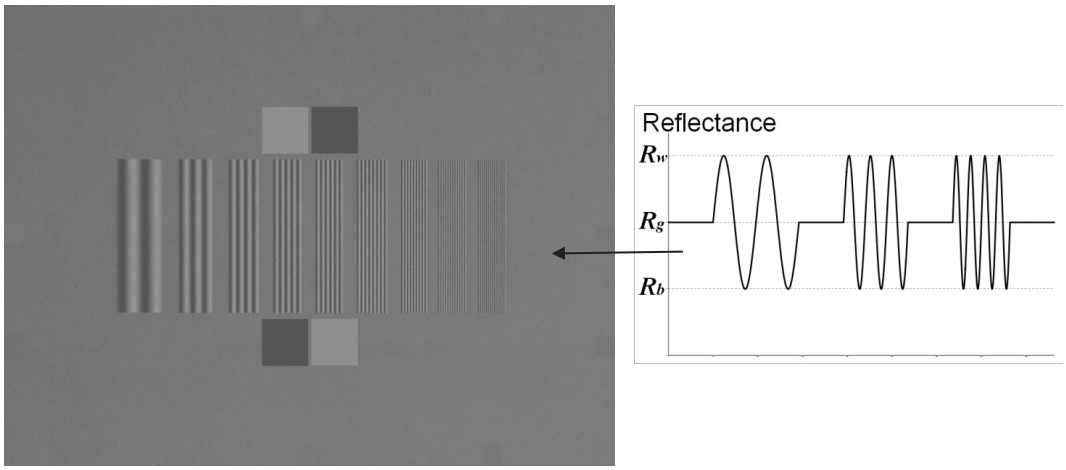

Figure 3 — Low contrast sine multiburst chart (general specification)

$$\frac{R_{\mathrm{w}}}{R_{\mathrm{g}}} = 1,5 \pm 0,05 \tag{1}$$

$$\frac{R_{\mathrm{b}}}{R_{\mathrm{g}}} = 0,5 \pm 0,05 \tag{2}$$

$$\frac{R_{\mathrm{w}} - R_{\mathrm{b}}}{R_{\mathrm{g}}} = 1,0 \pm 0,05 \tag{3}$$

$$R_{\mathrm{g}} = \left(18 \pm 2\right)\% \tag{4}$$

where

R_{w} is reflectance of bright peak;

R_{b} is reflectance of dark bottom;

R_{g} is reflectance of gray centre which is equal to reflectance of the background gray.

The chart includes light and dark patches adjacent to sine waves, which serve as reference areas for bright peak and dark bottom values. The reflectance of the patches is equal to the bright peak (R_{w}) and the dark bottom (R_{b}) of the sinusoidal chart.

For transmissive chart, equivalent transmittance is applied.

The relative size of the chart shall be less than or equal to 1/3 of the imaging area to suppress the risk of vignetting.

The test chart defined in Figure 3 shall be used in texture reproduction measurement. Other test charts with different gray centre level and/or the different amplitude value may also be used for measuring the reproduction of smaller or larger amplitude of texture.