TECHNICAL SPECIFICATION

ISO/TS 19567-2

First edition
2019-07

Corrected version
2019-11

Photography — Digital cameras —

Part 2: Texture analysis using stochastic pattern

Photographie — Caméras numériques —

Partie 2: Analyse de la texture en utilisant un modèle stochastique

Reference number
ISO/TS 19567-2:2019(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword ..... **iv**

Introduction ..... **v**

1 Scope **1**

2 Normative references **1**

3 Terms and definitions **1**

4 Test conditions and methods **1**
4.1 General 1
4.2 Environmental conditions 2
4.3 Apparatus and hardware 2
4.4 Arrangement of measuring equipment 2
4.4.1 Reflective test chart 2
4.4.2 Transmissive test chart 2
4.4.3 Lighting 3
4.4.4 Camera settings 3
4.5 Test Chart 4
4.5.1 General 4
4.5.2 Chart generation 4

5 Analytical approach **5**
5.1 General 5
5.2 Measurement method 6

6 Presentation of results **8**
6.1 SFR curve 8
6.2 Single numerical values 9
6.2.1 General 9
6.2.2 SFR10 9
6.2.3 SFR50 10
6.2.4 Texture acutance 10

Annex A (informative) **Differentiation of cyclic pattern and stochastic pattern** **12**

Annex B (informative) **Exposure condition for the measurement** **14**

Annex C (informative) **Inconsistency between results of the measurement method specified in this document and subjective evaluations** **17**

Bibliography **20**

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 jointly by Technical Committee ISO/TC 42, *Photography*.

A list of all parts in the ISO 19567 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.

This corrected version of ISO/TS 19567-2:2019 incorporates the following correction:

— The mention of the collaboration with IEC/TC 100, *Audio, video and multimedia systems and equipment*, was removed from the Foreword.

Introduction

In a general context, texture refers to the visual and tactile surface quality derived from the physicality of a material and the roughness or graininess of its surface. For digital still camera images, texture is restricted to the visual surface quality and the characteristic of texture reproduction in the captured image can be interpreted as the reproduction of the low contrast fine details. This document specifies the measurement of how cameras reproduce texture defined as low contrast fine details.

The on going tendency to utilize smaller sensors with higher pixel counts in some cameras leaves a very small amount of light reaching each 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 may 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 values of the surrounding pixels.

This document specifies methods to measure texture reproduction using test charts with a stochastic pattern. Annex A talks about the differentiation of this document from ISO/TS 19567-1, which deals with cyclic pattern. The test charts described here are based on randomly arranged circles of various sizes and colour with a limited contrast. This provides a target with known structure and spatial statistics similar to natural images. The measurement results are presented in SFR (Spatial Frequency Response) curves from which a single value representing the overall texture content is derived.

In general if one measured SFR is greater than the other across all measured spatial frequencies, a larger amount of texture is reproduced in the corresponding image. If two SFRs have a crossover point and the larger SFR depends on the frequency range, relative ordering of texture preservation quality is less clear. Comparison of the measurement results can provide important information about the relative texture reproduction of the captured images.

While the measurement method specified in this document is for objective evaluations of texture reproduction for images, their relationship to subjective evaluations of texture reproduction with visual perception is important to give attention, since image quality for camera/photograph users generally accords with subjective evaluation. Annex C explains possible inconsistency between measurement results using the method described in this document and subjective evaluations, due to different condition of noise, with experimental results for images.

Photography — Digital cameras —

Part 2: Texture analysis using stochastic pattern

1 Scope

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

This document specifies protocols for the measurement of texture reproduction using test charts with stochastic pattern.

NOTE The measurement method specified in this document is for objective evaluations of texture reproduction, of which the results are sometimes inconsistent with subjective evaluations (See Annex C).

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 http://www.iso.org/obp

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

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 and methods

4.1 General

The measurement shall be carried out using digital images of the texture test chart captured by a digital still camera.

The following measurement conditions should be used as nominal conditions when measuring the texture reproduction of a digital still camera. If it is not possible or appropriate to achieve these nominal operating conditions, the actual operating conditions shall be listed along with the reported results.

4.2 Environmental conditions

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

— Temperature: 23 °C ± 3 °C.

4.3 Apparatus and hardware

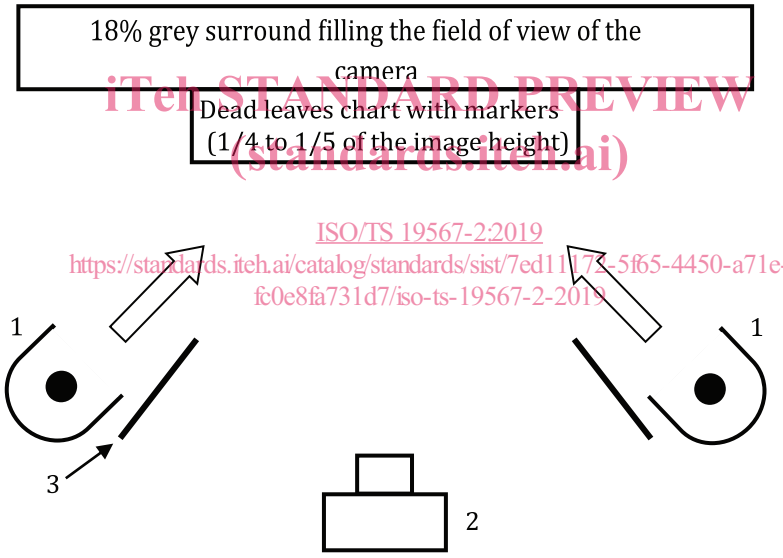
Either a reflective chart or a transmissive chart may be used. The light flux from the target shall be diffuse and shall not include any specular component.

Each test chart shall be specified, together with the lighting conditions such as illuminance, luminance and colour temperature of illumination.

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.



Key

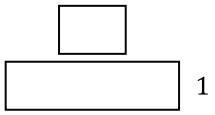
1 lamp
2 digital camera
3 baffles to prevent direct illumination of the camera lens by the lamps

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.

Lightbox with diffuser
Dead leaves chart with markers filling 1/4 to 1/5 of the image height surrounded by 18 % gray background filling the field of view



Key

1 digital camera

Figure 2 — Arrangement of measuring equipment for transmissive test chart

4.4.3 Lighting

The default colour temperature of the illumination shall be 5 700 K ± 1 000 K. For specific measurements a different colour temperature may be required. In this case the colour temperature shall be reported together with the results. 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/m^2 to 115 cd/m^2 for 18 % grey) is recommended when the measurement has no specified special 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.

4.4.4 Camera settings

The exposure should be adjusted to give the output value for the background grey 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 grey) = (max input luminance) × (grey reflectance)

For example in the case of an sRGB camera, the output Y for 18 % grey is 118 (8-bit) (see IEC 61966-2-1 and its amendment for details).

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

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 artifacts of compression. The texture reproduction for raw DSC image data should be measured for the output of the software that converts raw DSC image data into the final images. The name and the setting of the software 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.

4.5 Test Chart

4.5.1 General

“Test chart” shall be “Dead leaves chart with markers” dominating less than a quarter and greater than a fifth of the image height surrounded by an 18 % background. The field of view of the camera shall be covered by the 18 % grey background. The dead leaves chart (also known as spilled coins chart) consists of circles with a random size and colour laid on top of each other. See Figure 3 for a representation of the dead leaves chart.

A vector file of the recommended reference texture chart in EPS format, approximately 8 000 × 8 000 pixels in size is available at:

http://standards.iso.org/iso/ts/19567/-2/ed-1/en

The chart can be printed in various sizes, resolutions and contrast versions. However to reach comparable results the following instructions shall be used when capturing the chart. In order not to measure the resolution of the chart but the resolution of the camera the smallest circles in the chart shall be significantly smaller than the pixel of a camera it is projected on. The largest circle in the image shall cover at least 50 pixels in diameter. The contrast of the chart should be ±9 % around 18 % reflectance.

Additional charts at different mean grey and contrast levels may be used in addition to the above mentioned 18 % ± 9 % grey one.

The size of the Dead leaves with markers should be square and it should cover at least 350 × 350 pixels of the camera under test. To fulfil this and the image height requirement the number of pixels of the camera under test shall have more than 1 400 × 1 400 pixels. In case the camera under test has fewer pixels the height can be larger than a quarter of the field of view which shall be reported together with the results. For cameras with very low distortion it may cover the whole image but generally it should only cover a quarter of the image height to minimize potential distortion for registering the image with the original structure. The pattern can also be smaller and integrated into multi-purpose charts. It is recommended to place it close to the centre of the field of view to avoid lens performance related issues.

The chart shall be printed in a size that the actual printing resolution (not just the smallest printed dot) is at least double the camera sampling rate under the above mentioned chart and image height requirements. The provided sRGB encoded image shall be printed in a colour managed way to ensure the correct tonal and colour range.

4.5.2 Chart generation

The procedure for generating a list of circles for the dead leaves target is fairly straightforward and is in part outlined in Reference [10]. It is based on an occlusion model, with circles generated with a uniform distribution in digital level in the range between 0,09 and 0,27 of the maximum digital output level for each colour channel in a linear (in reflection or transmission) encoded image. A probability distribution should be selected that achieves a power spectral density that closely approximates $1/f^2$, which makes the chart scale-invariant. This can be accomplished with circle radii chosen according to a $1/r^3$ probability distribution, although there shall be an upper and lower bound for the radii (r_{min} and r_{max} respectively) to avoid full coverage by the smallest or largest circles, as discussed in Reference [10].

Typically, r_{min} is chosen such that the image size of the smallest circles will be much less than the image pixels when the target is projected onto the camera sensor array; r_{max} is selected to be much larger than r_{min}, but generally not larger than the width of the dead leaves image in the chart, W. The centre of each circle is randomly placed on a square canvas of width $W + 2r_{max}$; during the actual rendering (printing) phase it is assumed that only the centre $W \times W$ area is reproduced. Circles whose entire area falls outside of the inner $W \times W$ image are obviously excluded from the final list.

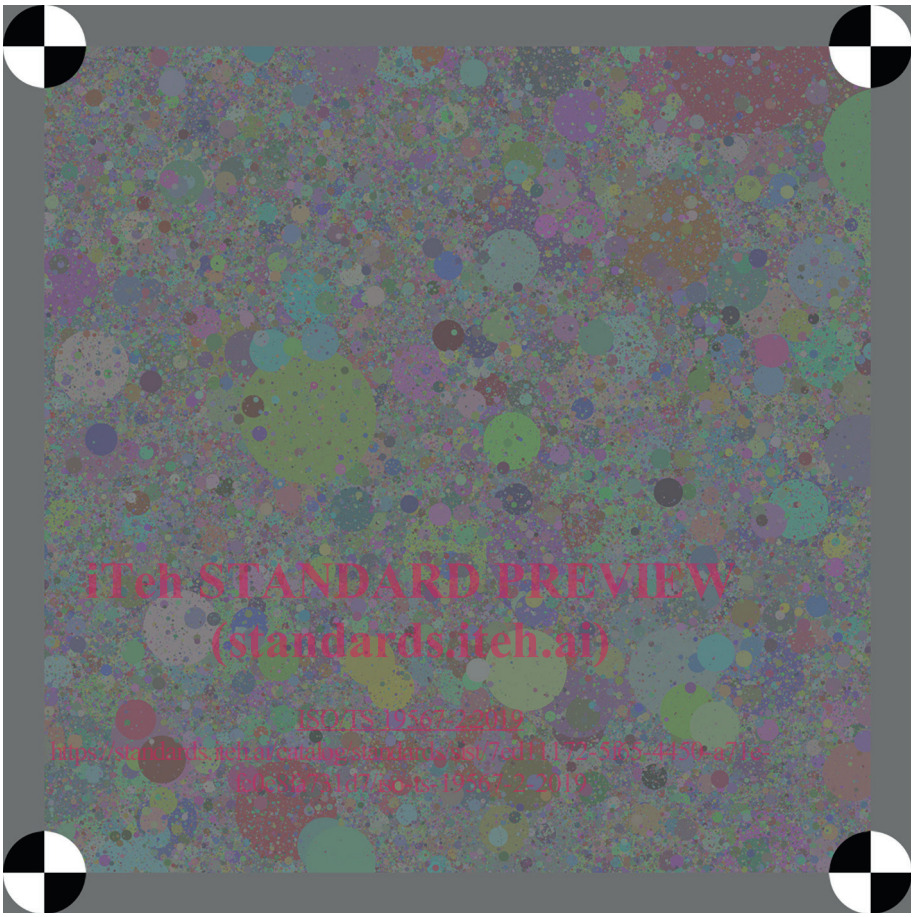


Figure 3 — Dead leaves chart with markers (central part of the test chart)

5 Analytical approach

5.1 General

Texture reproduction is measured from an image of the dead leaves target as described in this technical specification. The frequency characteristics of the texture reproduction are measured for various frequencies using a full reference method with the known spatial information of the pattern to obtain the complete transfer function.

To be able to neglect the local influence of geometric distortion on the target, the test pattern shall cover less than one quarter and more than one fifth of the image height and shall be located as close to the image centre as possible.

The dependency of the evaluation on the distortion has been tested for distortion levels of the Dead Leaves chart up to 3 % local geometric distortion according to ISO 17850. Any significant distortion above 3 % caused deviations in the measured spatial frequency response curve. Therefore this measurement method is only valid for distortion levels of the Dead Leaves chart up to 3 %. Distortion levels above that would need to be corrected prior to performing this analysis but be aware that distortion correction may affect the SFR measurement. In the case that distortion correction is