INTERNATIONAL STANDARD

ISO 17850

First edition
2015-07-01

Photography — Digital cameras — Geometric distortion (GD) measurements

Photographie — Caméras numériques — Mesurages de distorsion géométrique (DG)

Reference number
ISO 17850:2015(E)

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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).

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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*.

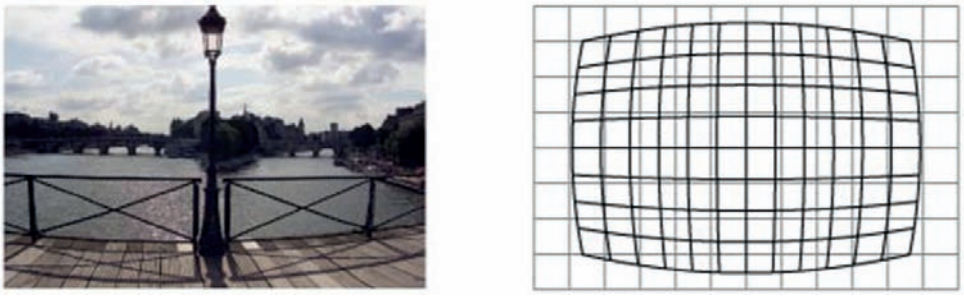
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Introduction

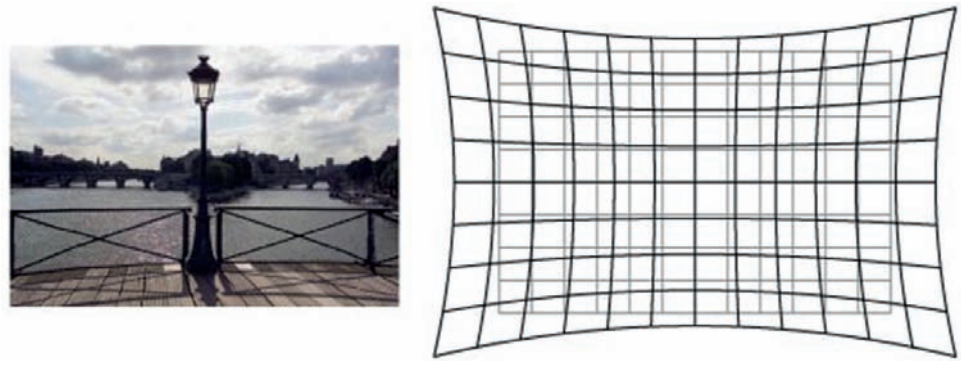
A digital still camera (DSC) typically employs a taking lens that is a rotationally symmetric optical system. Generally, the function of rotationally symmetric optical systems is to form an image that is geometrically similar to the object except some particular systems, such as fish-eye lenses and eyepieces, where this condition is deliberately not maintained. This function is accomplished ideally according to the geometry of perspective projection. Departures from the ideal image geometry are called distortion. The distortion is a position-dependent quantity which generally has a vectorial character. In a given image plane (which may also lie at infinity), this vector, representing the difference between theoretical and real image position, has a radial and a tangential component. In optical systems, the tangential component is basically conditioned by imperfect rotational symmetry. The systems manufactured in accordance with the present state of the art have a negligible tangential distortion.

Geometric distortion (GD) of DSCs is mainly caused by the variation of magnification in the image field of the camera lens. The most well-known effect of distortion is that straight lines appear curved. Generally speaking, the proportions between objects are not preserved in a distorted image, which can be very unpleasant for some natural scenes, architecture, or portraits. Distortion is fully described by a 2D map, giving the displacement from a point in an ideal undistorted image to the point in the actual distorted image. The image centre is usually assumed to be undistorted; the magnification factor at this position actually defines the focal distance.

Different types of distortion are usually characterized by how the magnification radially varies within the image field. Barrel and pincushion are the most usual types of distortion for which magnification is respectively monotonously decreasing and monotonously increasing when moving along from the centre to the border of the image field. Other types which cannot be categorized into above two types are usually called wave distortion.



a) Barrel (or negative) distortion



b) Pincushion (or positive) distortion

NOTE The magnification is decreasing for barrel distortion and increasing for pincushion.

Figure 1 — Two main types of distortions

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ISO 9039 defines methods to measure a lens that is separated from a camera. On the other hand, this International Standard was developed and defines methods to measure the total image distortion of a camera including a lens and signal processing.

This International Standard is based on both Reference [3] prepared by the Camera Phone Image Quality (CPIQ) group within the International Imaging Industry Association (I3A) and Reference [4] prepared by Camera and Imaging Products Association (CIPA).

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Photography — Digital cameras — Geometric distortion (GD) measurements

1 Scope

This International Standard specifies a protocol to measure geometric distortion of a digital camera. It is applicable to the measurement of digital cameras including camera phones.

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.

ISO 14524, *Photography — Electronic still-picture cameras — Methods for measuring opto-electronic conversion functions (OECFs)*.

IEC 61146-1, *Video cameras (PAL/SECAM/NTSC) — Methods of measurement — Part 1: Non-broadcast single-sensor cameras*

EBU Tech3249, *Measurement and analysis of the performance of film and television camera lenses*

3 Terms and definitions

3.1
geometric distortion
GD
<of DSC> displacement from the ideal shape of a subject (lying on a plane parallel to the image plane) in the recorded image

Note 1 to entry: Geometric distortion basically derives from variation of lateral magnification in the image field of a camera lens and results in straight lines being rendered as curves. There are other factors to induce geometric distortion, for example, rotational asymmetricity of a camera lens or position shift processing in a camera imaging process.

3.2
image height

3.2.1
image height
<of DSC> distance between an image point and the centre of the image area or its relative expression which is the value normalized by one half of the diagonal of the image area

Note 1 to entry: This is an extension of the definition in ISO 9039 which is a measurement for optical systems.

3.2.2
actual image height
<of DSC> image height of an actual recorded image point in the recorded image area

Note 1 to entry: “Actual recorded image point” corresponds to “observed image point” in ISO 9039.

Note 2 to entry: “Image height” in ISO 9039 basically means “actual image height” but the usage is sometimes confusing.

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