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Optics and optical instruments — Veiling glare of image-forming systems — Definitions and methods of measurement

Optique et instruments d'optique — Lumière parasite diffuse des systèmes d'imagerie — Définitions et méthodes de mesure

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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Introduction

The image plane of an optical or electrooptical imaging system normally receives not only the image forming radiation, but also stray (unwanted) radiation which can reduce image contrast.

This unwanted radiation is referred to as "veiling glare". In lens systems it usually arises from one or more of the following causes:

a) internal multiple reflections between the lens surfaces;

b) scatter from the surfaces of the lens elements due to scratches and other imperfections in the polish, dirt and dust, fingerprints, grease, poor antireflection coatings and faulty reflective coatings on mirrors;

c) bulk scatter from the interior of the glass and from bubbles and striae;

d) scatter from optical cements;

e) scatter and reflections from ground edges of the lens elements, from internal lens mounts and from the internal surfaces of the lens barrel;

f) reflections from the surfaces of diaphragms and shutter blades;

g) fluorescence of the glass optical cements.

The veiling glare of lens on its own can be considerably different from the veiling glare of a lens system and camera body combination. In the latter case, reflection of part of the image-forming radiation from the photosensitive material in combination with further reflections and scatter from the lens system and camera body contribute significantly to the veiling glare.

In electrooptical devices, veiling glare arises from similar causes. For instance, in an image intensifier tube glare can arise from:

a) radiation transmitted through the photocathode being scattered and reflected by internal structures back onto the photocathode;

b) radiation emitted from the phosphor going back to the photocathode;

c) in tubes with microchannel plates some electrons incident on the input face can be back-scattered from this face before returning to it with the primary electrons.

For the purposes of this International Standard, it is important to differentiate between veiling glare which originates from radiation incident on the entrance pupil or input face of an optical or electrooptical system and other factors which may cause a reduction in contrast and which may therefore influence a measurement of veiling glare.

Examples of these are:

a) radiation entering a system through leaks in the casing or body of the system;

b) radiation from internal sources in a system such as LEDs;

c) reflection of ambient radiation from projection screens or CRT displays;

d) dark current in electrooptical devices;

e) fog in photographic emulsions.

There are two principle methods of measuring veiling glare, namely the integral (or black patch) and the analytical (or glare spread function).

In the integral method, the target object is a small black area surrounded by an extended uniform source. The veiling glare index (VGI) is specified as the ratio of the irradiance in the image of the black area to the irradiance in the image of the extended source. For definitions of this and other radiometric and photometric terms, see ISO 31-6.

In the analytical method, the object is a small source with a dark surround. The distribution of irradiance in the image plane normalised in a particular way, is defined as the glare spread function (GSF).

Each of these two methods of measuring veiling glare has its own particular areas of usefulness. In general, the integral method is applicable to systems where the scene will normally be of roughly uniform radiance (e.g. a landscape photographed in overcast conditions or with the sun behind the camera) whilst the analytical method is relevant to applications where intense isolated sources may be present in the scene (e.g. a star sensor system on a space vehicle, designed to operate with the sun just outside its field of view).

The analytical method has the further advantage that in principle it can be used to calculate glare levels in a specified real situation and in fact the VGI can be predicted from the GSF (e.g. by convolution and integration of the GSF with the radiance distribution in the scene) whilst the reverse is not possible.

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1 Scope

This International Standard adopts both the veiling glare index (VGI) and the glare spread function (GSF) as measures of the veiling glare characteristics of optical and electrooptical imaging systems. Laboratory measurement techniques are described in general terms and recommendations are made regarding the performance of the main subunits of the equipment.

The measurement techniques described in this International Standard are chiefly valid for the visual spectral range. For adjacent spectral ranges, modifications of these techniques will possibly be necessary.

Standard methods of specifying conditions of test and of expressing the results are given, while to assist in the intercomparison of VGI figures, standard test conditions are specified.

This International Standard also gives guidelines for the operation of measuring equipment such that accurate results can be achieved.

Results of veiling glare index measurements made using equipment which does not conform in detail to the configurations described in this International Standard are accepted as valid, provided the method of measurement is substantially similar (i.e. measures the ratio of the radiance in the image of the black area to the radiance in a surrounding bright field) and provided the test results can be correlated to the required accuracy with results obtained on equipment which conforms strictly to this International Standard.

2 Definitions

For the purposes of this International Standard, the following definitions apply.

2.1 veiling glare: Unwanted irradiation in the image plane of an optical or electrooptical system, caused by a proportion of the radiation which enters the system through its normal entrance aperture. The radiation may be from inside or outside the field of view of the system.

2.2 veiling glare index (VGI): Ratio of the irradiance at the centre of the image of a small, circular, perfectly black area superimposed on an extended field of uniform radiance, to the irradiance at the same point of the image plane when the black area is removed. VGI is expressed as a percentage unless otherwise specified.

NOTE 1 The size of the black area and of the surrounding field, as well as the proportion of the black area used for measurement, shall be specified.

2.3 veiling glare index — band target (VGIB): Ratio of the irradiance at a specified position along the centreline of the image of a narrow, perfectly black band superimposed on an extended field of uniform radiance, to the irradiance at the same point of the image plane when the black band is removed. VGIB is expressed as a percentage unless otherwise specified.

NOTE 2 The black band, or strip, shall extend across a diagonal of the image format. Its width and length, as well as the size of the surrounding field and the proportion of the black area used for measurement shall be specified.

2.4 glare spread function (GSF): Irradiance distribution in the image plane, produced by a small source object, normalised to unit total flux in the on-axis image of the small source.