
**Photography — Psychophysical
experimental methods for estimating
image quality —**

**Part 1:
Overview of psychophysical elements**

*Photographie — Méthodes psychophysiques expérimentales pour
estimer la qualité d'image —*

Partie 1: Aperçu général des éléments psychophysiques



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Contents

Page

Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Specification of the experimental conditions and results	5
4.1 Observer characteristics.....	5
4.2 Stimulus properties	6
4.3 Instructions to the observer	6
4.4 Viewing conditions	7
4.5 Experimental duration	7
4.6 Results	8
4.7 Summary of reported quantities	8
Annex A (informative) Selection of an appropriate psychophysical method	9
Annex B (informative) Stimulus differences, paired comparison proportions, and JNDs	11
Annex C (informative) Example of a report of a psychophysical experiment	13
Annex D (informative) Comparison of selected psychometric methods	15
Bibliography	17

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

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.

ISO 20462-1 was prepared by Technical Committee ISO/TC 42, *Photography*.

ISO 20462 consists of the following parts, under the general title *Photography — Psychophysical experimental methods for estimating image quality*:

- *Part 1: Overview of psychophysical elements*
- *Part 2: Triplet comparison method*
- *Part 3: Quality ruler method*

Introduction

There are many circumstances under which it is desirable to quantify image quality in a standardized fashion that facilitates interpretation of results within a given experiment and/or comparison of results between different experiments. Such information can be of value in assessing the performance of different capture or display devices, image processing algorithms, etc. under various conditions. There are a number of psychometric methods described in the literature, such as paired comparison, rank ordering, categorical sort, and magnitude estimation, which might be considered as candidates for experimentally measuring image quality. Several textbooks^{[1] [3] [4] [5] [9] [12]} have reviewed these and other methods and have discussed associated data reduction techniques, which usually are based upon the approach of Thurstone^[11] or analogous reasoning. However, the choice of the best method for a particular application may be difficult to make, and interpretation of the rating scales produced by the numerical analyses is frequently ambiguous. Furthermore, none of the commonly used techniques provides an efficient mechanism for calibration of the results against a standardised numerical scale or associated physical references, which is desirable when results of different experiments are to be compared or integrated. The value of new calibrated psychometric methods in developing comprehensive models of imaging system quality has been demonstrated in a recent work^[6] that contains more detailed discussions of many of the informative topics superficially considered herein.

The three parts of ISO 20462 address the need for documented means of determining image quality in a calibrated fashion. Part 1 provides an overview of practical psychophysics; specific experimental methods and associated data reduction techniques are described in Part 2 (triplet comparison method^{[8] [10]}) and Part 3 (quality ruler method^[6]). Informative Annex A aids in identifying the better choice between the two alternative methods of Parts 2 to 3, which are complementary and together are sufficient to span a wide range of applications. It is the intent of these methods to produce results that are not merely directional in nature, but are expressed in terms of relative or fixed scales that are calibrated in just noticeable differences (JNDs), so that the significance of experimentally measured stimulus differences is readily ascertained.

Photography — Psychophysical experimental methods for estimating image quality —

Part 1: Overview of psychophysical elements

1 Scope

This part of ISO 20462 is part of a multiple-part standard pertaining to the subjective evaluation of pictorial still image quality. This part of ISO 20462

- a) defines the units by which image quality is quantified (just noticeable differences, or JNDs);
- b) describes the influence of stimulus properties, observer characteristics, and task instructions on results obtained from rating experiments;
- c) provides a flow chart for choosing the preferred psychophysical method for determining image quality from among those defined in subsequent parts of ISO 20462.

2 Normative references

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

ISO 3664, *Viewing conditions — Graphic technology and photography*

3 Terms and definitions

For the purpose of this document, the following terms and definitions apply:

3.1

artefactual attribute

attribute of image quality that, when evident in an image, nearly always leads to a loss of overall image quality

EXAMPLE Examples of artefactual attributes include noise and aliasing.

NOTE The commonly used terms *defect* and *impairment* are similar in meaning.

3.2

attribute

aspect, dimension, or component of overall image quality

cf. **artefactual attribute** (3.1) and **preferential attribute** (3.12)

EXAMPLE Examples of image quality attributes include image structure properties such as sharpness and noise; colour and tone reproduction properties such as contrast, colour balance, and relative colourfulness; and digital artefacts such as aliasing, contouring, and compression defects.

3.3 attribute just noticeable difference

attribute JND

measure of the detectability of appearance variations, corresponding to a stimulus difference that leads to a 75:25 proportion of responses in a paired comparison task in which univariate stimuli pairs are assessed in terms of a single attribute identified in the instructions

cf. **quality JND** (3.14)

NOTE 1 As an example, a paired comparison identifying the sharper of two stimuli that differ only in their generating system modulation transfer function (MTF), would yield results in terms of sharpness attribute JNDs. If the MTF curves differed monotonically and did not cross, the outcome of the paired comparison would depend primarily upon the observers' ability to detect changes in the appearance of the stimuli as a function of MTF variations, with little or no value judgement required of the observers. The relationship between paired comparison proportions and stimulus differences is discussed in greater detail in Annex B.

NOTE 2 If observers are instead asked to choose which of a pair of stimuli is higher in overall image quality, and if the stimuli in aggregate are multivariate, such that the observer should make value judgements of the importance of a number of attributes, rather than focussing on one aspect of image appearance, it is observed experimentally that larger objective stimulus differences (for example, MTF changes) are required to obtain a 75:25 proportion of responses, which in this case corresponds to a quality JND.

NOTE 3 A JND is a statistical quantity, derived from a number of observations. An observer assessing a single pair of images differing by one attribute JND is unlikely to be confident that he or she has detected the sample difference. A stimulus difference of approximately three JNDs is usually needed for an observer of average sensitivity to feel reasonably certain of his or her assessment.

3.4 categorical sort method

psychophysical method involving the classification of a stimulus into one of several ordered categories, at least some of which are identified by adjectives or phrases that describe different levels of image quality or attributes thereof

NOTE The application of adjectival descriptors is strongly affected by the range of stimuli presented, so that it is difficult to compare the results of one categorical sort experiment to another. Range effects and the coarse quantization of categorical sort experiments also hinder conversion of the responses to JND units. Given these limitations, it is not possible to unambiguously map adjectival descriptors to JND units, but it is worth noting that in some experiments where a broad range of stimuli have been presented, the categories *excellent*, *very good*, *good*, *fair*, *poor*, and *not worth keeping* have been found to provide very roughly comparable intervals that average about six quality JNDs in width.

3.5 image quality

impression of the overall merit or excellence of an image, as perceived by an observer neither associated with the act of photography, nor closely involved with the subject matter depicted

NOTE The purpose of defining image quality in terms of third-party (uninvolved) observers is to eliminate sources of variability that arise from more idiosyncratic aspects of image perception and pertain to attributes outside the control of imaging system designers.

3.6 instructions

set of directions given to the observer for performing the psychophysical evaluation task

3.7 just noticeable difference

JND

stimulus difference that leads to a 75:25 proportion of responses in a paired comparison task

cf. **attribute JND** (3.3) and **quality JND** (3.14)