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Information technology — Plenoptic image coding system (JPEG Pleno) —

Part 7: Light field quality assessment

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialised system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

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 document 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 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 the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

A list of all parts in the ISO 21794 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.

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Introduction

The ISO/IEC 21794 standard, also known as JPEG Pleno, aims to provide a standard framework for representing plenoptic imaging modalities. A plenoptic image modality can be a light field, a point cloud, or a hologram, which are sampled representations of the plenoptic function. The plenoptic function describes the radiance, in time and space, obtained by positioning a pinhole camera at every viewpoint in 3D spatial coordinates, every viewing angle, and every wavelength, resulting in a 7D function.

This document provides methodologies and recommendations for subjective quality assessment of lossy decoded data of light field modality in the context of multiple use cases.

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Information technology — Plenoptic image coding system (JPEG Pleno) —

Part 7:
Light field quality assessment

1 Scope

This document specifies protocols and reporting requirements for the subjective quality assessment of lossy decoded light field data. It defines viewing conditions, visualisation procedures, rating protocols, post-processing methods and reporting formats to obtain repeatable and comparable subjective results.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes the requirements 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/IEC 21794-2, *Plenoptic image coding system (JPEG Pleno)—Part 2: Light field coding.*

ITU-R BT.500-15, *Methodologies for the subjective assessment of the quality of television images*

ITU-T P.910, *(10/2023), Subjective video quality assessment methods for multimedia applications. Version 6. Published. International Telecommunications Union*

3 Terms and definitions

For the purposes of this document, the terms, definitions, and abbreviated terms given in ISO/IEC 21794-1, and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

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

3.1
absolute category rating
a subjective assessment method where observers rate the absolute quality of a stimulus on a predefined scale

3.2
angular resolution
ability to distinguish different angles of incoming light rays in a light field, determined by the density of viewpoints captured in the angular domain

3.3
bitstream
compressed data representation that includes all necessary data to allow a (full or approximate) reconstruction of the sample values of a digital image

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3.4
Bradley-Terry model
a probabilistic model for paired comparison data, mapping preferences to a quality scale using a logistic distribution

3.5
coding
encoding or decoding

3.6
coding process
a general term for referring to an encoding process, a decoding process, or both

3.7
compression
reduction in the number of bits used to represent source image data

3.8
compression artefacts
visual distortions introduced during image or video compression, such as blocking, blurring, geometric distortions, or inter-view inconsistencies

3.9
decoder
embodiment of a decoding process

3.10
decoding process
process which takes as its input compressed image data and outputs a continuous-tone image

3.11
degradation category rating
a subjective assessment method where observers evaluate the level of annoyance caused by impairments, relative to a source (reference) image

3.12
depth
distance of a point in 3D space to the camera plane

3.13
double stimulus
a quality assessment method where both the test and source stimuli are presented

3.14
encoder
embodiment of an encoding process

3.15
encoding process
process that takes as its input a continuous-tone image and outputs compressed image data

3.16
framing effect
influence of how questions or tasks are presented (positively or negatively framed) on observers' evaluations or decisions

3.17
full parallax
parallax in both horizontal and vertical directions

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3.18
holography
a technique for capturing and reproducing the amplitude and phase of light waves to create volumetric 3D representations of scenes or objects

3.19
hologram
sampled representation of the plenoptic function in the form of a complex wavefront

3.20
horizontal parallax
parallax in the horizontal direction

3.21
just noticeable difference
unit of a perceptual scale corresponding to the smallest difference in quality between two stimuli that is detectable by 75 % of observers

3.22
light field
sampled representation of the plenoptic function in the form of a vector function that represents the radiance of a discretised set of light rays

3.23
light field data
recorded light field

3.24
lossy
descriptive term for encoding and decoding processes which are not lossless

3.25
observer bias
cognitive or psychological tendencies that may influence an observer's subjective evaluation of image or video quality

3.26
parallax
effect whereby the position or direction of an object appears to differ when viewed from different positions

3.27
pixel
collection of sample values in the spatial image domain having all the same sample coordinates, e. g. a pixel may consist of three samples describing its red, green and blue values

3.28
plenoptic content
imaging content that incorporates additional degrees of freedom beyond planar 2D representation, such as light fields, point clouds, and holograms

3.29
plenoptic function
function describing radiance in time and space obtained by positioning a pinhole camera at every viewpoint in 3D spatial coordinates, every viewing angle, and every wavelength, resulting in a 7D representation

3.30
point cloud
sampled representation of the plenoptic function in the form of a collection of points with position and attribute information

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3.31
single stimulus
a quality assessment method where observers evaluate a single test stimulus without a source (reference)

3.32
spatial resolution
width and height (in pixels) of an image or view, determining the level of detail captured in the content

3.33
stereoscopic vision
ability to perceive depth from binocular disparity, critical for 3D image quality assessment

3.34
stimulus
visual content presented to the observer during a subjective test, including source (reference) and processed (test) light field data

3.35
Thurstone's Case V model
a statistical model that maps paired comparison data to a quality scale using a normal distribution

3.36
vertical parallax
parallax in the vertical direction

3.37
visual discomfort
viewer discomfort caused by stereoscopic content due to excessive depth disparity, crosstalk, or abrupt changes in vergence load

4 Symbols and abbreviated terms

4.1 Symbols

T	Total test duration for each observer.
t	Time per stimulus in the subjective experiment, composed of t_d, the duration of visualisation (e.g., a pseudo-video in passive mode), and t_r, the time taken by the observer to decide.
S	Number of source contents.
B	Number of operating points (bitrates).
C	Number of codecs or coding conditions.
$q_{scb}^{(o)}$	Quality score given by observer *o* for a stimulus generated from source *s*, and encoded by codec *c*, at bitrate *b*.
$\overline{q}_{scb}$	Mean opinion score across *n* observers for a stimulus generated from source *s*, and encoded by codec *c,* at bitrate *b*.
V^o	Comparison matrix for observer *o* where each element of the matrix v_{ij}^o shows the result of comparison of stimulus *i* over stimulus *j*.
N_{qi}^s	Refers to the number of stimuli generated from source *s*, all sharing the same quality score q_i from the subjective experiment.
M	Number of groups assigned for the pairwise comparison experiment.

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