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Part 2: Light field coding

Technologies de l'information — Système de codage d'images plénoptiques (JPEG Pleno) —

Partie 2: Codages des champs de lumière

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Foreword

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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 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 or www.iec.ch/members_experts/refdocs).

This 2nd edition of ISO/IEC 21794-2 ("Plenoptic image coding system (JPEG Pleno) Part 2: Light field coding") integrates AMD1 of ISO/IEC 21794-2 (“Profiles and levels for JPEG Pleno Light Field Coding”) and includes the specification of an additional coding mode, entitled Slanted 4D transform mode and its associated profile.

ISO/IEC 21794-2 ("Plenoptic image coding system (JPEG Pleno) Part 2: Light field coding") specifies two coding modes: the 4D transform mode and the 4D prediction mode. The 4D prediction mode is efficient for light fields of all baselines but depends on the availability of accurate depth information. The 4D transform mode, although not relying on any sort of depth information, is only efficient for coding narrow baseline light fields. The Slanted 4D transform mode, based on 4D transformations, is efficient for light fields with both narrow and wide baselines and does not rely on the availability of depth information.

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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. In the IEC, see www.iec.ch/understanding-standards.

This document was prepared by Joint 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/IEC 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 and www.iec.ch/national-committees.

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Introduction

This document is part of a series of standards for a system known as JPEG Pleno. This document defines the JPEG Pleno framework. It facilitates the capture, representation, exchange and visualization of plenoptic imaging modalities. A plenoptic image modality can be a light field, point cloud or hologram, which are sampled representations of the plenoptic function in the form of, respectively, a vector function that represents the radiance of a discretized set of light rays, a collection of points with position and attribute information, or a complex wavefront. The plenoptic function describes the radiance in time and in 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.

JPEG Pleno specifies tools for coding these modalities while providing advanced functionality at system level, such as support for data and metadata manipulation, editing, random access and interaction, protection of privacy and ownership rights.

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

Part 2:
Light field coding

1 Scope

This document specifies a coded codestream format for storage of light field modalities as well as associated metadata descriptors that are light field modality specific. This document also provides information on the encoding tools.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes 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.

ITU-T Rec. T.800, | *ISO/IEC 15444-1, Information technology — JPEG 2000 image coding system — Part 1: Core coding system*

ITU-T Rec. T.801, | *ISO/IEC 15444-2, Information technology — JPEG 2000 image coding system — Part 2: Extensions*

ISO/IEC 21794-1:2020, *Information technology — Plenoptic image coding system (JPEG Pleno) — Part 1: Framework*

ISO/IEC 60559, *Information technology — Microprocessor Systems — Floating-Point arithmetic*

ITU-T T.81, | *ISO/IEC 10918-1, Information technology – Digital compression and coding of continuous-tone still images – Requirements and guidelines*

ITU-T Rec. T.84, | *ISO/IEC 10918-3, Information technology – Digital compression and coding of continuous-tone still images: Extensions*

3 Terms and definitions

For the purposes of this document the terms and definitions 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 http://www.electropedia.org/

3.1
arithmetic coder
entropy coder that converts variable length strings to variable length codes (encoding) and vice versa (decoding)

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3.2
bit-plane
two-dimensional array of bits

3.3
4D bit-plane
four-dimensional array of bits

3.4
coefficient
numerical value that is the result of a transformation or linear regression

3.5
compression
reduction in the number of bits used to represent source image data

3.6
depth
distance of a point in 3D space to the camera plane

3.7
disparity view
image that for each pixel of the subaperture view contains the apparent pixel shift between two subaperture views along either horizontal or vertical axis

3.8
hexadeca-tree
division of a 4D region into 16 (sixteen) 4D subregions

3.9
pixel
collection of sample values in the spatial image domain having all the same sample coordinates

EXAMPLE A pixel may consist of three samples describing its red, green and blue value.

3.10
plenoptic function
amount of radiance in time and in space by positioning a pinhole camera at every viewpoint in 3D spatial coordinates, every viewing angle and every wavelength, resulting in a 7D representation

3.11
reference view
subaperture view that is used as one of the references to generate the intermediate views

3.12
subaperture view
subaperture image
image taken of the 3D scene by a pinhole camera positioned at a particular viewpoint and viewing angle

3.13
texture
pixel attributes

EXAMPLE Colour information, opacity, etc.

3.14
transform
transformation
mathematical mapping from one signal space to another

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4 Symbols and abbreviated terms

4.1 Symbols

Codestream_Body()	coded image data in the codestream without Codestream_Header()
Codestream_Header()	codestream header preceding the image data in the codestream
$\tilde{D}^{DEC}(t,s,v,u)$	decoded normalized disparity value at view (t,s) for pixel location (v,u)
$\tilde{D}(t,s,v,u)$	normalized disparity value at view (t,s) for pixel location (v,u)
$DPEC_k$	pointer to contiguous codestream for normalized disparity view k
D_{shift}	scaling parameter to translate quantized normalized disparity maps to positive range
DCODEC	disparity view codec type
f	focal length
FPW_p	fixed-weight merging parameter for view p
$H(t,s)$	view hierarchy value for view (t,s)
$HCC(t,s)$	horizontal camera centre coordinate for view (t,s)
$H_D(t,s)$	binary value defining the availability of a normalized disparity view (t,s)
J_0	Lagrangian encoding cost
J_1	Lagrangian encoding cost of spatial partitioning
J_2	Lagrangian encoding cost of view partitioning
$KR_{p,c}$	sparse filter regressor mask of texture component c for view p
LightField()	JPEG Pleno light field codestream
$LSW_j^{p,c}$	quantized least-squares merging weight of texture component c for view p, $j=1,2,\ldots,NLS_p$
MIDV	absolute value of the minimum value over all quantized normalized disparity views
$MMODE_p$	view merging mode for intermediate view p
MSP_p	sparse filter order for view p
NLS_p	number of least-squares merging coefficients for intermediate view p
NRT_p	regressor template size parameter for sparse filter for view p
NC	number of components in an image
N_I	number of intermediate views
N_{NDV}	number of reference normalized disparity views
N_p^D	number of normalized disparity reference views for intermediate view p
N_p^T	number of texture reference views for intermediate view p

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