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ISO/IEC 23090-12

# Information technology — Coded representation of immersive media —

## Part 12: MPEG immersive video

*Technologies de l'information — Représentation codée de média immersifs —*

*Partie 12: Vidéo immersive MPEG*

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

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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*.

This second edition cancels and replaces the first edition (ISO/IEC 23090-12:2023), which has been technically revised.

The main changes are as follows:

— Additional functionality: colourized geometry, capture device information, patch margins, background views, static background atlases, support for decoder-side depth estimation, chroma dynamic range modification, piecewise linear normalized disparity quantization, and linear depth quantization was added.

A list of all parts in the ISO/IEC 23090 series can be found on the ISO and IEC websites.

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 was developed to support compression of immersive video content, in which a real or virtual 3D scene is captured by multiple real or virtual cameras. The use of this document enables storage and distribution of immersive video content over existing and future networks, for playback with 6 degrees of freedom of view position and orientation.

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# Information technology — Coded representation of immersive media —

# Part 12: MPEG immersive video

## 1 Scope

This document specifies the syntax, semantics and decoding processes for MPEG immersive video (MIV), as an extension of ISO/IEC 23090-5. It provides support for playback of a three-dimensional (3D) scene within a limited range of viewing positions and orientations, with 6 Degrees of Freedom (6DoF).

## 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.

ISO/IEC 14496-10:2022, *Information technology — Coding of audio-visual objects — Part 10: Advanced video coding*

ISO/IEC 23008-2:2023, *Information technology — High efficiency coding and media delivery in heterogeneous environments — Part 2: High efficiency video coding*

ISO/IEC 23090-3:2021, *Information technology — Coded representation of immersive media — Part 3: Versatile video coding*

ISO/IEC 23090-5:2025, *Information technology — Coded representation of immersive media — Part 5: Visual Volumetric video-based coding (V3C) and Video-based point cloud compression (V-PCC)*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 23090-5 and the following apply.

ISO and IEC maintain terminology 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**
**background view**
view that may be synthesized or acquired to include scene elements that would otherwise be excluded by other scene elements that are closer to the view position, and may consist of V3C component frames that are static or rarely-changing parts of an MIV scene

**3.2**
**capture device**
hardware capable of observing a scene and thereby acquiring one or more video components

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**3.3**
**capture device information**
**CDI**
collection of one or more physical models with the aim of compensating for zero or more undesirable acquisition aspects inherent to applied *capture devices* (3.2)

**3.4**
**coded MIV sequence**
*coded V3C sequence* conforming to the constraints specified in this document

**3.5**
**decoding process**
process specified in this document that reads a *bitstream* and derives *patch data* and related information that can be used to render a *viewport* (3.30)

**3.6**
**decoding order**
order in which syntax elements are processed by the *decoding process* (3.5)

**3.7**
**distortion parameters**
physical model of the lens distortion of a *sensor* (3.18) of a *capture device* (3.2)

**3.8**
**field of view**
**FOV**
angular region of the observable world in captured/recorded content or in a physical display device

**3.9**
**MIV access unit**
*V3C composition unit* that is a set of all *sub-bitstream access units* (3.21) that share the same *decoding order* (3.6) count

**3.10**
**MIV coded sub-bitstream sequence**
*sub-bitstream IRAP access unit* (3.22) followed by zero or more *sub-bitstream access units* (3.21)

Note 1 to entry: An *MIV coded sub-bitstream sequence* is a *coded sub-bitstream sequence* conforming to the constraints specified in this document.

**3.11**
**MIV IRAP access unit**
*MIV access unit* (3.9) for which all *sub-bitstream access units* (3.21) are *sub-bitstream IRAP access units* (3.22)

Note 1 to entry: An *MIV IRAP access unit* is a *V3C IRAP composition unit* conforming to the constraints specified in this document.

**3.12**
**MIV toolset profile component**
toolset profile component with ptl_profile_toolset_idc equal to 64 (MIV Main), ptl_profile_toolset_idc equal to 65 (MIV Extended), ptl_profile_toolset_idc equal to 66 (MIV Geometry Absent), ptl_profile_toolset_idc equal to 67 (MIV 2), or ptl_profile_toolset_idc equal to 68 (MIV Simple MPI)

Note 1 to entry: The definition can be extended to accommodate future toolset profile components.

**3.13**
**multi-plane image**
**MPI**
set of pairs of texture and transparency *attribute frames*, each associated with an implicit constant *geometry frame*

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**3.14**
**normalized disparity**
inverse of the depth value associated with a *view sample* (3.15), expressed in scene units$^{-1}$

**3.15**
**light source**
physical or logical component of a *capture device* (3.2) for active illumination of the captured scene

**3.16**
**pivot**
point corresponding to the junction of two consecutive line segments in a piece-wise linear scaling of the inverse of depth values

**3.17**
**renderer**
embodiment of a process to create a *viewport* (3.30) from a *volumetric frame* corresponding to a *viewing orientation* (3.27) and *viewing position* (3.28)

**3.18**
**sensor**
physical or logical component of a *capture device* (3.2) that provides a *video component*

**3.19**
**source**
one or more video sequences, each containing *geometry* or an *attribute* such as texture and transparency information before encoding

**3.20**
**source view**
*source* (3.19) video material before encoding that corresponds to the format of a *view* (3.23), which may have been acquired by capture of a 3D scene by a real or virtual camera

**3.21**
**sub-bitstream access unit**
partition of a *sub-bitstream* that has a certain *decoding order* (3.6) count

Note 1 to entry: *A sub-bitstream access unit* is a *sub-bitstream composition unit*.

**3.22**
**sub-bitstream IRAP access unit**
*sub-bitstream access unit* (3.21) that forms an independent random-access point for the *sub-bitstream*

Note 1 to entry: *A sub-bitstream IRAP access unit* is a *sub-bitstream IRAP composition unit*.

**3.23**
**view**
2D rectangular arrays of *view samples* (3.26) consisting of *attribute* frames and corresponding *geometry* frame representing the projection of a *volumetric frame* onto a surface using *view parameters* (3.24)

**3.24**
**view parameters**
parameters of the projection used to generate a *view* (3.23) from a *volumetric frame*, including intrinsic and extrinsic parameters

**3.25**
**view parameters list**
listing of one or more *view parameters* (3.24)

**3.26**
**view sample**
position on the rectangular frame associated with a *view* (3.23)

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**3.27**
**viewing orientation**
unit quaternion representing the orientation of a user who is consuming the visual content

**3.28**
**viewing position**
triple of x, y, z characterizing the position in the Cartesian coordinates of a user who is consuming the visual content

**3.29**
**viewing space**
domain constraints for an intended *viewport* (3.30) rendering

Note 1 to entry: The domain is defined in the 3D global space and related to the *viewing orientation* (3.27); it defines a scale between 0 and 1 for every point in space for a given direction of the *viewport* (3.30), to be used by the application.

**3.30**
**viewport**
*view* (3.23) suitable for display and viewing

## 4 Abbreviated terms

For the purposes of this document, the abbreviated terms given in ISO/IEC 23090-5 and the following apply.

| | |
|---|---|
| CSG | constructive solid geometry |
| ERP | equirectangular projection |
| MIV | MPEG immersive video |
| OMAF | Omnidirectional media format |

## 5 Conventions

The specifications in ISO/IEC 23090-5:2025, Clause 5 and its subclauses apply with the following additions. to subclause 5.8 of ISO/IEC 23090-5:2025:

Cos( x ) the trigonometric cosine function operating on an argument x in units of radians

Dot( x, y ) dot product function, known also as scalar product function, operating on two vectors x and y

Norm( x ) = Sqrt( Dot( x, x ) )

Sin( x ) the trigonometric sine function operating on an argument x in units of radians

π the ratio of a circle's circumference to its diameter

## 6 Overall V3C characteristics, decoding operations, and post-decoding processes

The specifications in ISO/IEC 23090-5:2025, Clause 6 apply.

The decoded video frames can benefit from the application of additional transformations, as described in Annex B, before any reconstruction operations. For example, the different components can be time-aligned and converted to a nominal video format.

Informative hypothetical transcoding and rendering processes are available in Annex E.

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