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# Introduction

This document aims to clarify all MPEG-I-Visual latest activities as briefly as possible (from outputs of previous meeting and inputs of the previous and the current meetings), such that future missing activities of MPEG-I-Visual can be identified. Updates of this document may be provided per meeting so that in one brief document all activities and future steps can be read.

# Rationale and Current Activities

Following the informal descriptions of Table 1 (formal definitions can be found in the latest version of the Technical Report on Architectures for Immersive Media, i.e [N17264](http://wg11.sc29.org/doc_end_user/current_document.php?id=60801&id_meeting=172) at the present meeting cycle), MPEG-I Visual is an activity that addresses the specific requirements of Immersive Visual Media, up to six Degrees of Freedom virtual walkthroughs, including their capture and rendering with dedicated cameras and displays, typically referred to as Light Field devices.

The following sections give an overview of important documents over the past meetings, providing requirements, use cases, software tools, test material, exploration experiments, subjective viewing results, demonstrations, recommendations and future activities.

At this stage of the process, Exploration Experiments for various flavors of immersive experiences have been defined, with following latest descriptions corresponding to this meeting cycle:

* [N17463](http://wg11.sc29.org/doc_end_user/current_document.php?id=61337&id_meeting=173) Exploration Experiments for MPEG-I: Windowed-6DoF
* [N17464](http://wg11.sc29.org/doc_end_user/current_document.php?id=61338&id_meeting=173) Exploration Experiments for MPEG-I: Omnidirectional 6DoF
* [N17465](http://wg11.sc29.org/doc_end_user/current_document.php?id=61339&id_meeting=173) Exploration Experiments for MPEG-I: Dense Light Field Compression

The document titles relate to the current main activities, following the description of Table 1.

Important actions w.r.t. test material can be found in the following document:

* [N17462](http://wg11.sc29.org/doc_end_user/current_document.php?id=61336&id_meeting=173) Call for MPEG-I Visual Test Materials on 6DoF

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| **Abbreviation** | **Informal Description** |
| MPEG-I Visual | Covers the Visual technologies of Immersive media in MPEG-I |
| 360 video | Panoramic video texture projected onto a virtual shape (often a sphere) surrounding the user’s head, out of which he/she visualizes a portion for an immersive video experience. |
| DoF | Degrees of Freedom |
| 3DoF | 3 Degrees of Freedom, i.e. allow movements along head rotation axes |
| 3DoF+ | 3DoF with also small translational movements of the head within a restricted volume, typically a person sitting in a couch |
| 6DoF | 6 Degrees of Freedom, i.e. allow movements along 3 rotation axes and 3 translations. Without further specifications, 6DoF presumes that full freedom of movement through the scene is possible. |
| Omnidirectional 6DoF | A restricted form of 6DoF, or an extended form of 3DoF allowing – besides of unrestricted rotations - small translational movements of the body within a restricted volume, typically a person taking a few steps from a central position, with the ability to look all around (cf. omnidirectional). |
| Windowed 6DoF | A restricted form of 6DoF where the user virtually views the scene from behind a (virtual) window, with any position allowing to still see at least part of the scene. |
| FTV | Free viewpoint TeleVision |
| FN | Free Navigation, i.e. the capability to create all views required (cf. view synthesis) to create a smooth, virtual walkthrough between successive viewing positions |
| Epipolar Line | The line on which a feature point in a first camera view will necessarily lie in another camera view, as a consequence of a physical/optical relationship between cameras. Only parallel cameras have horizontal Epipolar Lines |
| EPI | Epipolar Plane Image, i.e. an image composed of corresponding Epipolar Line sections over all input camera views |
| EE | Exploration Experiment |
| Disparity | The displacement of a feature (typically all pixels) in the scene when viewed from one to another camera view. Disparity and Depth are inverse proportional to each other. Disparity is often used in the reference software, but a language abuse often wrongly refers to Depth instead of Disparity. |
| Depth Estimation | Estimation of depth for each visible point in the scene, by evaluating the Disparity between at least two adjacent camera views |
| View Synthesis | The process of synthesizing a virtual view from existing input camera views, typically by a disparity/depth-dependent interpolation process |
| DIBR | Depth Image-Based Rendering, where images are rendered based on depth information. It is the typical process used in image-based View Synthesis. |
| DERS | Depth Estimation Reference Software, estimating depth from camera views by methods similar to stereo matching |
| DERS-1Dfast | A simplified version of DERS for strictly parallel cameras, i.e. with horizontal (1D) Epipolar Lines |
|  |  |
| VSRS | View Synthesis Reference Software, synthesizing a virtual view from existing input camera views |
| VSRS-1D | A simplified version of VSRS for strictly parallel cameras, i.e. with horizontal (1D) Epipolar Lines |
| HEVC | High Efficiency Video Coding |
| HTM | 3D-HEVC Test Model software. |
| HNSS | Hybrid Natural and Synthetic Scene description |
| MV | MultiView, i.e. multiple views of the scene, typically in the order of a dozen of views |
| MVD | MultiView+Depth, adding depth to MultiView content |
| Autostereoscopic Display | MultiView display, typically with a dozen of directional output views, providing a stereoscopic viewing experience without wearing 3D glasses. |
| SMV | Super-MultiView, i.e. MultiView with many captured and/or rendered views (several dozens to hundreds) |
| SMV display | An advanced Autostereoscopic Display device with several dozens to hundreds of directional output views, often restricted to providing horizontal parallax only stereoscopic viewing |
| Light Field | A conceptual representation of light, where in addition to luminance or color, also directional information is captured from each light ray emanating from a point in space. The concept of Light Field is often related to sampling of the Plenoptic function |
| Plenoptic function | A mathematical description of the Light Field with up to 7 parameters (3 spatial position coordinates, 2 angular direction coordinates, the light wavelength/color, and time) |
| Sparse Light Field | A coarsely sampled Light Field, e.g. captured with a discrete set of cameras |
| Light Field Camera System | A camera device/system where each pixel captures luminance/color and directional light information from the Plenoptic function, e.g. with a discrete set of cameras, a Plenoptic Camera, etc. |
| Plenoptic Camera | Light Field Camera where in addition to the luminance/color, the directional light information of the Plenoptic function is obtained through an array of microlenses, correctly refracting light to the underlying pixels |
| Dense Light Field | A Light Field with light rays densely packed into the volume of interest (the so-called field of view), typically captured with Plenoptic Cameras, or synthesized/raytraced from 3D visual media representations |
| Light Field Display | An Autostereoscopic Display device, more advanced than SMV displays, to render a Dense Light Field, typically supporting full parallax and correct eye accommodation at very high light ray densities. |
| Stereo Sweeping  View Sweeping | A method of sweeping from one view to the next (including virtual views) to evaluate the quality of the view synthesis |
| Perceptual metric | A quality metric incorporating the Human Visual System characteristics. This metric should correlate to subjective quality experiences |

Table 1: Abbreviations used throughout the document. The reader is referred to the latest version of the “Technical Report on Architectures for Immersive Media” for formal definitions.

# Overviews

Documents that consist of overviews are:

* [N17460](http://wg11.sc29.org/doc_end_user/current_document.php?id=61334&id_meeting=173) Summary on MPEG-I Visual Activities on 6DoF (This document)
* [N17461](http://wg11.sc29.org/doc_end_user/current_document.php?id=61335&id_meeting=173) Overview of MPEG-I Visual Test Materials
* [N17285](http://wg11.sc29.org/doc_end_user/current_document.php?id=60821&id_meeting=172) MPEG-I Visual activities on 6DoF and Light Fields
* [N17135](http://wg11.sc29.org/doc_end_user/current_document.php?id=60672&id_meeting=172) Survey on assessing subjective quality of immersive media applications and services
* [N17264](http://wg11.sc29.org/doc_end_user/current_document.php?id=60801&id_meeting=172) Working Draft of Technical Report on Architectures for Immersive Media

# Use cases

Documents that consist of use cases are:

* [N17330](http://wg11.sc29.org/doc_end_user/current_document.php?id=61213&id_meeting=173) MPEG-I Use Cases

# Requirements

Documents that consist of requirements are:

* [N17073](http://wg11.sc29.org/doc_end_user/current_document.php?id=60035&id_meeting=171) Requirements on 6DoF (v1)

# Reference software

* [N17133](http://wg11.sc29.org/doc_end_user/current_document.php?id=60670&id_meeting=172) Limitations of multi-view extensions of HEVC and fixes for MPEG-I Phase 2
* [N17459](http://wg11.sc29.org/doc_end_user/current_document.php?id=61333&id_meeting=173) Issues affecting the usage of HEVC reference software for experimental studies (Document was discussed during the 30th JCT-VC meeting and based mainly on issues mentioned in N17133)
* [N16730](http://wg11.sc29.org/doc_end_user/current_document.php?id=57637&id_meeting=) Depth map formats used within MPEG 3D technologies
* [N15349](http://wg11.sc29.org/doc_end_user/current_document.php?id=52901&id_meeting=) FTV Software Framework
* HTM [1]

# Test Materials

Documents that consist of test materials are:

* [N17462](http://wg11.sc29.org/doc_end_user/current_document.php?id=61336&id_meeting=173) Call for MPEG-I Visual Test Materials on 6DoF

# Exploration Experiments

Documents that consist of exploration experiments are:

* [N17463](http://wg11.sc29.org/doc_end_user/current_document.php?id=61337&id_meeting=173) Exploration Experiments for MPEG-I: Windowed-6DoF
* [N17464](http://wg11.sc29.org/doc_end_user/current_document.php?id=61338&id_meeting=173) Exploration Experiments for MPEG-I: Omnidirectional 6DoF
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# Future activities and Recommendations

We recommend at least following future activities in all EEs:

* Having two or more participants per EE sub-item to allow for cross checking,
* Subjective viewing for all EEs,
* Finalizing all anchor results for all current EE’s,
* Defining anchor configurations for DERS and VSRS to make it easier to report improvements.
* Increasing the number of test sequences per meeting,
* Specifying missing types of content within the test materials.

# References

[1] G. Tech and Y. Chen and K. Müller and J. R. Ohm and A. Vetro and Y. K. Wang*, Overview of the Multiview and 3D Extensions of High Efficiency Video Coding*, IEEE Transactions on Circuits and Systems for Video Technology, vol. 26, pp. 35–49, 2016.

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