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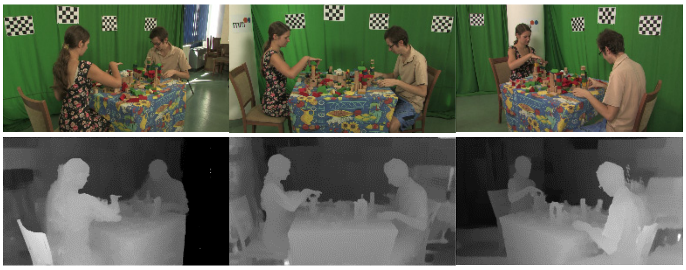
3D-HEVC extension for circular camera arrangements



The 3D-HEVC is the state-of-the-art compression technology for 3D video in "multiview video and depth" format (MVD). This technology has been developed by Collaborative Team on 3D Video Coding Extensions Development (JCT-3V) formed between ISO/IEC and ITU-T and is foreseen to be incorporated into the HEVC standard (High Efficiency Video Coding) as Annex I of ISO/IEC MPEG-H Part 2 and ITU-T Recommendation H.265.

The 3D-HEVC is built on the top of the MV-HEVC codec. The MV-HEVC utilizes inter-view prediction between the views. The goal of the 3D-HEVC was to exploit information about 3D scene structure (in form of depth maps) to increase coding efficiency of 3D video. During the development of the 3D-HEVC technology, explicit 1D parallel views arrangement has been assumed. Therefore, the 3D-HEVC coding efficiency for non-linear camera arrangements is far from optimal.

Many modern Super Multiview (SMV) displays require circular (arc) view arrangements for better user experience. Therefore, efficient compression technology for non-linear (e.g. arc) camera arrangements is of great interest.

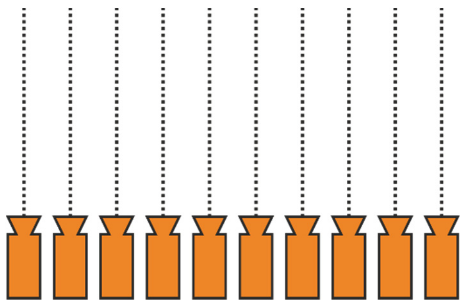
Multiview+Depth (MVD)

The MVD content consist of set of views with corresponding depth maps. Ability of transition of depth maps along with coded video in single 3D-HEVC stream allows for rendering more output views than the number of coded camera feeds, using Depth Image Based Rendering techniques. The transmission of MVD content requires effective compression techniques.

Camera Arrangements

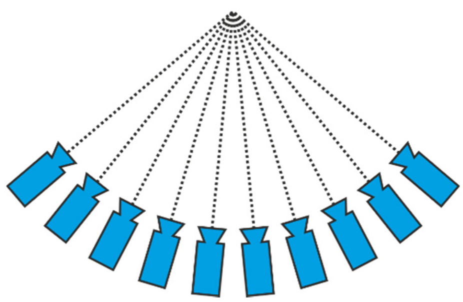
Linear arrangement:

- Parallel optical axes
- Most common for MVD development
- All views can be rectified
- Narrow range of viewpoint selection



Arc arrangement

- Converging optical axes
- Required by some modern Super Multiview (SMV) displays
- Wide range of viewpoint selection
- Rectification possibility is reduced



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Developed Codec

Extension of 3D-HEVC towards compression of video acquired with arc camera arrangement systems have been included.

All depth related coding tools generalized:

- removal of view arrangement restrictions
- support for arbitrary camera location described by camera parameters
- disparity vectors are calculated by using projection matrices for both the reference view and the view being coded

Modified disparity vector derivation process in tools:

- Disparity Compensated Prediction (DCP)
- Neighboring Block Disparity Vector (NBDV)
- Depth oriented NBDV (DoNBDV)
- View Synthesis Prediction (VSP)
- Inter-view Motion Prediction (IvMP)
- Illumination Compensation (IC)

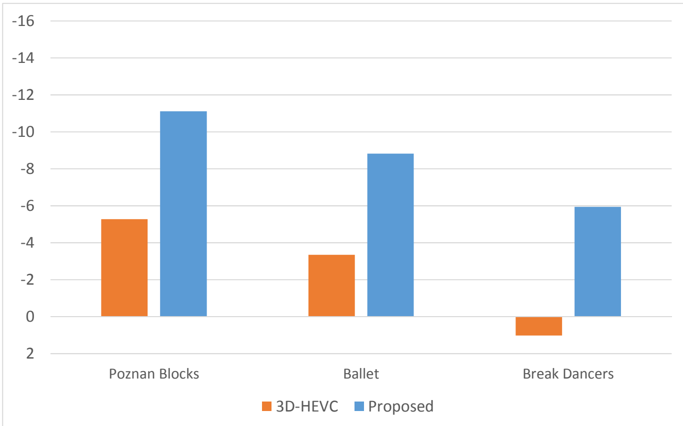
Support for high accuracy depth maps (up to 16 bits/sample) required to achieve high quality synthesis in wide angle arc camera arrangement sequences.

Transmission of all required camera parameters:

- focal length along horizontal $\boldsymbol{f_x}$ and vertical $\boldsymbol{f_y}$ direction
- position of camera optical center along horizontal $\boldsymbol{c_x}$ and vertical $\boldsymbol{c_y}$ axis
- position of the camera optical center along x axis T_x,
- translation vector $\boldsymbol{T}$ with coordinates of camera position ($\boldsymbol{T_x}$, $\boldsymbol{T_y}$ and $\boldsymbol{T_z}$)
- rotation matrix $\boldsymbol{R}$

Compression efficiency

View arrangement	Sequence	BD-Rate [%]		
		Proposed vs 3D-HEVC	Proposed vs MV-HEVC	3D-HEVC vs MV-HEVC
Linear	Poznan Street	0,05	-7.10	-7.11
	Poznan Hall 2	0,09	-9.14	-9.18
	Dancer	0,02	-14.34	-14.36
	Balloons	0,08	-8.21	-8.20
	Kendo	0,09	-6.05	-6.08
	Newspaper	0,04	-14.26	-14.28
	Average	**0,06**	**-9.85**	**-9.87**
Arc	Poznan Blocks	-6,17	-11.11	-5.28
	Ballet	-5,68	-8.82	-3.35
	Break Dancers	-6,89	-5.94	1.02
	Average	**-6,25**	**-8.62**	**-2.54**



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