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| **Joint Collaborative Team on 3D Video Coding Extension Development**  **of ITU-T SG 16 WP 3 and ISO/IEC JTC 1/SC 29/WG 11**  2nd Meeting: Shanghai, CN, 13–19 Oct. 2012 | Document: JCT3V-B0034 |

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| *Title:* | **3D-CE1.h Results on View Synthesis Prediction** | | |
| *Status:* | Input Document | | |
| *Purpose:* | Proposal | | |
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# Abstract

This document describes the results of RWTH Aachen University's contribution to Core Experiment 1 for High Efficiency Video Coding (HEVC) based 3D Video Coding. The Core Experiment investigates the impact of view synthesis based prediction on texture and depth coding for the additional views.

The proposed method was implemented into the 3DV-HTM reference software 4.0.1 and evaluated according to the common test conditions [[1](#Hei11)]. The results are provided in terms of rate and distortion. BD-Rates comparing the proposed method and the anchor encodings are also attached to this document.

# Introduction

After having reconstructed video and depth map of the base view, this information is utilized to generate warped representations of the base view for every additional view to be (de-)coded. This is accomplished by taking camera parameters into account, which are provided for each view and coded in the bitstream.

The warped picture is added to the reference picture list right before the inter-view reference picture. After the insertion of the warped prediction picture into the reference picture list, the coding process continues completely the same way as without the addition of the proposed view synthesis prediction (VSP) scheme.

The proposed modifications to the HEVC coding scheme have only an impact on high level syntax as the decoder treats the synthesized reference picture the same way as any other reference picture, e.g. inter-view reference pictures or inter frame reference pictures.

# Details on Implementation

The proposed algorithm was implemented into the 3DV-HTM 4.0.1 reference software. All modifications to the source code are encapsulated in preprocessor statements (RWTH\_VSP), which makes it possible to (de-)activate the coding tool easily.

The algorithm and its implementation do not interfere with other coding tools of the reference software and can reuses coding tools, which are already in the reference software.

# Discussion of Complexity Measurements

The simulations to generate the attached results were executed on a cluster system with ~100 processing cores. The overall cluster configuration is relatively heterogeneous and therefore the provided encoding and decoding timings are not very reliable and should only be seen as an approximate of the real complexity in- or decrease.

# Simulation Results

## 3 View Test Case

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | video 0 | video 1 | video 2 | video only | synthesized only | coded & synthesized | enc time | dec time |
| Balloons | 0,0% | 1,3% | 2,4% | 0,9% | 0,7% | 0,8% | 168,4% | 205,5% |
| Kendo | 0,0% | 1,0% | 1,8% | 0,6% | 0,6% | 0,7% | 162,2% | 180,7% |
| Newspaper\_CC | 0,0% | 0,6% | 0,6% | 0,3% | 0,6% | 0,6% | 160,6% | 193,0% |
| GT\_Fly | 0,0% | -1,1% | -0,1% | -0,1% | 0,1% | 0,1% | 143,5% | 168,9% |
| Poznan\_Hall2 | 0,0% | 0,0% | 1,5% | 0,4% | 0,4% | 0,4% | 152,7% | 180,3% |
| Poznan\_Street | 0,0% | -2,9% | -1,9% | -0,8% | -0,3% | -0,4% | 151,1% | 180,5% |
| Undo\_Dancer | 0,0% | -1,5% | -0,9% | -0,2% | -0,2% | -0,2% | 167,6% | 211,3% |
| 1024x768 | 0,0% | 1,0% | 1,6% | 0,6% | 0,6% | 0,7% | 163,7% | 192,8% |
| 1920x1088 | 0,0% | -1,4% | -0,4% | -0,2% | 0,0% | 0,0% | 153,5% | 184,6% |
| **average** | **0,0%** | **-0,4%** | **0,5%** | **0,1%** | **0,3%** | **0,3%** | **157,8%** | **188,1%** |

## 2 View Test Case

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | video 0 | video 1 |  | video only | synthesized only | coded & synthesized |
| Balloons | 0,0% | 1,3% |  | 0,4% | 0,4% | 0,4% |
| Kendo | 0,0% | 1,0% |  | 0,3% | 0,4% | 0,4% |
| Newspaper\_CC | 0,0% | 0,6% |  | 0,2% | 0,4% | 0,3% |
| GT\_Fly | 0,0% | -1,1% |  | -0,1% | 0,0% | 0,0% |
| Poznan\_Hall2 | 0,0% | 0,0% |  | 0,0% | 0,2% | 0,1% |
| Poznan\_Street | 0,0% | -2,9% |  | -0,6% | -0,1% | -0,2% |
| Undo\_Dancer | 0,0% | -1,5% |  | -0,2% | -0,2% | -0,2% |
| 1024x768 | 0,0% | 1,0% |  | 0,3% | 0,4% | 0,4% |
| 1920x1088 | 0,0% | -1,4% |  | -0,2% | 0,0% | -0,1% |
| **average** | **0,0%** | **-0,4%** |  | **0,0%** | **0,1%** | **0,1%** |

# Cross Check

The cross check was done by Qualcomm. They investigated changes to the software and compared their simulation results with the presented results. In their investigations they did not find any problems with the software. Their simulation results perfectly match the presented results in terms of decoded texture and depth.  
For the synthesized views the PSNR values differed minimally. Due to some configuration problem on RWTH Aachen University’s side the PSNR values are slightly lower compared to Qualcomm’s results. The over all performance of the proposal is not affected by this difference.

# References

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| [1] | Dmytro Rusanovskyy Heiko Schwarz, "Common Test Conditions for HEVC- and AVC-based 3DV," ISO/IEC JTC1/SC29/WG11 MPEG, N12560 2012. |

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# Patent rights declaration(s)

**RWTH Aachen University may have current or pending patent rights relating to the technology described in this contribution and, conditioned on reciprocity, is prepared to grant licenses under reasonable and non-discriminatory terms as necessary for implementation of the resulting ITU-T Recommendation | ISO/IEC International Standard (per box 2 of the ITU-T/ITU-R/ISO/IEC patent statement and licensing declaration form).**