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| *Title:* | **CE1.h related: Clean-ups for BVSP in 3D-HEVC** | | |
| *Status:* | Input Document | | |
| *Purpose:* | Proposal | | |
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# Abstract

In the current implementation of backward view synthesis prediction (BVSP) in 3D-HEVC, a BVSP merging candidate is added with its reference index set to -1. In addition, BVSP mode flags need to be maintained in decoded picture buffer (DPB) and utilized for several modules, such as de-blocking filter, temporal merging candidate derivation, motion parameter inheritance for depth coding, depth-oriented neighboring block disparity vector (Do-NBDV). However, majority of these changes are not reflected in the working draft. To reduce the unnecessary complication and complexity introduced by additional checking of BVSP mode flags and additional memory, it is proposed to align the software with the working draft by modifying the reference index of BVSP merging candidate and remove the storage of BVSP mode flags in DPB. In this way, BVSP coded blocks could be considered transparently as normal Inter predicted blocks. The contribution reports an average coding gain of 0.1% for texture views, and 0.1% for synthesized views in terms of bitrate reduction.

# Introduction

In current 3D-HTM, BVSP is enabled for skip/merge mode by adding a special candidate to the merge candidate list. This new candidate, i.e., BVSP merging candidate is constructed with the following settings [1]:

* Prediction direction: bi-prediction for B slices and uni-prediction for P slices
* Reference index of each reference picture list: -1.
* Motion vector of each reference picture list: the derived disparity vector from Do-NBDV [2]
* A BVSP mode flag to indicate the usage of BVSP mode is set to 1

For all the other merging candidates, a BVSP mode flag is set to 0. Although bi-prediction is associated with the BVSP merging candidate in the software, uni-prediction from the inter-view reference picture is performed during the motion compensation process.

# Problem

The prediction units coded with BVSP mode are predicted from the inter-view reference picture while the reference index is set to -1. Such a design may have the following problems:

* Several modules may need to be modified: instead of just checking intra/inter mode, one more condition should be also checked, i.e., the BVSP mode flag equal to 1 or not.
  + For example, the design of deblocking filter, temporal merging candidate, Do-NBDV, AMVP.
* The BVSP mode flag in 16x16 unit should be stored together with other motion information in decoded picture buffer. It may be accessed during the temporal merging candidate derivation process.
* For motion parameter inheritance (MPI), the MPI candidate derived from the co-located texture block is first derived. If the co-located texture block is coded with BVSP mode, the MPI candidate is replaced by the BVSP merging candidate created by current depth block. Therefore, MPI is disabled for this case. The replacement increases the complexity and requires the storage of BVSP mode flags after one texture slice is decoded.
* The prediction direction is set to bi-prediction in the software while it is set to uni-prediction in the specification.

# Proposal

It is proposed to remove all the additional checking of BVSP mode by replacing the reference index by the inter-view reference picture index after the merge candidate list is constructed. Therefore, there is no need to change the modules mentioned above and store the BVSP mode flags in DPB which reduces the complexity for hardware implementation and aligns with some of existing HEVC modules.

# Simulations results

The proposed method was implemented into 3D-HTM v6.0. Simulation results of the proposal are shown in Table 1. Simulations were conducted following common test conditions [3].

As shown in Table 1, the proposed clean-ups bring 0.1% coding gain for both texture views, and synthesized views. Note the encoding and decoding time may be not accurate because of hybrid CPUs used for the simulations.

Table 1: Proposed Method VS HTM 6.1 (CTC)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | video 1 | video 2 | video PSNR / video bitrate | video PSNR / total bitrate | synth PSNR / total bitrate | enc time | dec time | ren time |
| Balloons | -0.2% | -0.2% | -0.1% | -0.1% | -0.1% | 93% | 112% | 105% |
| Kendo | -0.1% | -0.1% | -0.1% | -0.1% | -0.1% | 92% | 112% | 93% |
| Newspaper\_CC | -0.2% | 0.0% | 0.0% | -0.1% | 0.0% | 95% | 115% | 94% |
| GT\_Fly | 0.2% | -0.2% | 0.0% | -0.1% | -0.1% | 97% | 108% | 98% |
| Poznan\_Hall2 | 0.1% | 0.1% | 0.0% | -0.1% | 0.0% | 91% | 113% | 91% |
| Poznan\_Street | -0.1% | -0.2% | -0.1% | -0.1% | -0.1% | 90% | 115% | 92% |
| Undo\_Dancer | 0.0% | -0.2% | 0.0% | -0.1% | -0.1% | 95% | 110% | 94% |
| 1024x768 | -0.2% | -0.1% | -0.1% | -0.1% | -0.1% | 93% | 113% | 97% |
| 1920x1088 | 0.1% | -0.1% | 0.0% | -0.1% | -0.1% | 93% | 111% | 94% |
| **average** | 0.0% | -0.1% | -0.1% | -0.1% | -0.1% | 93% | 112% | 95% |

# References

1. D. Tian, F. Zou, A. Vetro (MERL), "CE1.h: Backward View Synthesis Prediction using Neighboring Blocks", JCT3V-C0152, Geneva, CN, Jan. 2013.
2. Yu-Lin Chang, Chi-Ling Wu, Yu-Pao Tsai, and Shawmin Lei, "CE1.h: Depth-oriented Neighboring Block Disparity Vector (DoNBDV) with virtual depth retrieval", JCT3V-C0131, Geneva, CN, Jan. 2013.
3. D. Rusanovskyy, K. Mueller, A. Vetro, "Common Test Conditions of 3DV Core Experiments", JCT3V-B1100, Shanghai, CN, October 2012.

# Patent rights declaration(s)

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