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| *Title:* | **3D-CE1.h related :simplifications on view synthesis prediction** | | |
| *Status:* | Input Document | | |
| *Purpose:* | Proposal | | |
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# Abstract

In HTM 6.0, view synthesis prediction (VSP) uses the scheme of depth oriented neighboring block disparity vector (DoNBDV) to derive a depth block to perform the backward warping operation for both texture and depth coding. However, it is observed that VSP does not introduce sufficient coding gain for depth coding in current design. In this contribution, it is proposed to disable VSP for depth coding. Moreover, for each VSP coded CU, the current VSP needs to access depth blocks of the reference view twice and these two accessed depth blocks may be totally un-overlapped. To reduce the memory bandwidth of the reference depth data access, it is further proposed to simply use the neighboring block disparity vector (NBDV) instead of DoNBDV for VSP so that the access time of depth block for each VSP coded CU could be reduced from two to one. The experimental results reportedly show that disabling VSP for depth coding causes no BD-rate change and the proposed VSP using NBDV can even achieve 0.1% BD-rate saving for overall coded and synthesized views compared to HTM-6.0 while the memory bandwidth to access the reference depth data is reduced. The experimental results also show that the combination of the proposed two simplifications brings 0.1% BD-rate saving for overall coded and synthesized views.

# Introduction

In HTM-6.0 [1], view synthesis prediction (VSP) uses the neighboring blocks to derive a depth block to perform the backward warping operation, and it is applied for both texture and depth coding. However, two issues have been observed. First, applying VSP in depth map coding does not improve the coding efficiency at all. Second, the memory access bandwidth for disparity vector (DV) derivation of VSP needs to access the reference depth map twice and could be further reduced. Details for the second issue are explained in the next paragraph.

As shown in Figure 1 (a), the depth oriented neighboring block disparity vector (DoNBDV) is utilized to derive a DV for VSP. In the scheme of DoNBDV, the derived DV from neighboring block disparity vector (NBDV) is used to retrieve a depth block in the reference view to derive a refined DV. Secondly, the refined DV is used to fetch another depth block for VSP.

 

1. (b)

**Figure 1. The derivation of depth block for VSP**

# Proposed method

In this contribution, we propose two simplifications to VSP:

1. Disable VSP for depth coding.
   1. Remove the VSP candidate from merge candidate list for depth coding.
   2. For MPI mode, if the collocated texture block uses VSP mode, current PU in depth map will simply inherit the disparity vectors of the collocated texture block to do the inter-view disparity compensation instead of inheriting the VSP mode.
2. Remove the refined DV procedure in VSP, and the derivation of depth block for VSP can be simplified as shown in Figure 1 (b).

# Experimental results

The proposed simplifications are integrated into HTM-6.0[1], and all tests are conducted under the common test conditions [2]. The experimental results of simplification 1, simplification 2 and the combination of simplification 1 and simplification 1 are shown in Table 1, Table 2, and Table 3, respectively. It shows that disabling the VSP for depth coding causes no BD-rate change, and the proposed VSP without the refined DV procedure can even achieve 0.1% BD-rate saving for overall coded and synthesized views compared to HTM-6.0 while the memory bandwidth to access the reference depth data is reduced. The experimental results also shows that the combination of the proposed two simplifications brings 0.1% BD-rate saving for overall coded and synthesized views.

**Table 1. The results of simplification 1 (disabling VSP for depth coding)**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Video 1 | Video 2 | Video only | video/total bitrate | synth / total bitrate | Enc time | Dec time | Ren time |
| Balloons | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 99.9% | 98.6% | 102.1% |
| Kendo | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 100.2% | 97.0% | 102.3% |
| Newspapercc | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 100.7% | 94.5% | 100.5% |
| GhostTownFly | 0.0% | 0.0% | 0.0% | -0.1% | -0.1% | 99.7% | 101.8% | 101.5% |
| PoznanHall2 | 0.0% | 0.0% | 0.0% | 0.0% | 0.1% | 100.4% | 98.4% | 98.6% |
| PoznanStreet | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 99.8% | 103.8% | 99.8% |
| UndoDancer | 0.0% | 0.0% | 0.0% | -0.1% | -0.2% | 99.9% | 95.5% | 102.2% |
| 1024x768 | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 100.2% | 96.7% | 101.6% |
| 1920x1088 | 0.0% | 0.0% | 0.0% | -0.1% | 0.0% | 99.9% | 99.9% | 100.5% |
| **average** | **0.0%** | **0.0%** | **0.0%** | **0.0%** | **0.0%** | **100.1%** | **98.5%** | **101.0%** |

**Table 2. The results of simplification 2 (using NBDV for VSP)**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Video 1 | Video 2 | Video only | video/total bitrate | synth / total bitrate | Enc time | Dec time | Ren time |
| Balloons | -0.1% | 0.0% | 0.0% | 0.0% | -0.1% | 100.4% | 96.9% | 101.1% |
| Kendo | 0.1% | 0.0% | 0.0% | 0.0% | 0.0% | 100.3% | 98.0% | 101.6% |
| Newspapercc | 0.0% | 0.1% | 0.0% | 0.0% | 0.0% | 100.1% | 95.5% | 100.5% |
| GhostTownFly | 0.1% | 0.2% | 0.0% | 0.0% | 0.0% | 100.3% | 95.8% | 99.7% |
| PoznanHall2 | -0.3% | -0.3% | -0.1% | -0.1% | -0.1% | 100.2% | 93.5% | 104.5% |
| PoznanStreet | 0.4% | 0.2% | 0.1% | 0.1% | 0.1% | 100.3% | 105.4% | 100.1% |
| UndoDancer | 0.1% | 0.2% | 0.0% | 0.0% | -0.4% | 100.7% | 99.6% | 95.5% |
| 1024x768 | 0.0% | 0.1% | 0.0% | 0.0% | 0.0% | 100.3% | 96.8% | 101.1% |
| 1920x1088 | 0.1% | 0.1% | 0.0% | 0.0% | -0.1% | 100.4% | 98.6% | 100.0% |
| **average** | **0.0%** | **0.1%** | **0.0%** | **0.0%** | **-0.1%** | **100.3%** | **97.8%** | **100.4%** |

**Table 3. The results of combination of simplification 1 and simplification 2**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Video 1 | Video 2 | Video only | video/total bitrate | synth / total bitrate | Enc time | Dec time | Ren time |
| Balloons | -0.1% | 0.0% | 0.0% | 0.0% | 0.0% | 100.1% | 94.9% | 98.6% |
| Kendo | 0.1% | 0.0% | 0.0% | 0.0% | 0.1% | 99.8% | 97.3% | 101.0% |
| Newspapercc | 0.0% | 0.1% | 0.0% | 0.0% | -0.1% | 99.7% | 93.0% | 100.0% |
| GhostTownFly | 0.1% | 0.2% | 0.0% | 0.0% | -0.1% | 100.0% | 94.9% | 101.8% |
| PoznanHall2 | -0.3% | -0.3% | -0.1% | -0.2% | -0.1% | 100.4% | 100.0% | 99.4% |
| PoznanStreet | 0.4% | 0.2% | 0.1% | 0.0% | 0.0% | 99.8% | 94.2% | 98.7% |
| UndoDancer | 0.1% | 0.2% | 0.0% | 0.0% | -0.5% | 98.9% | 97.7% | 102.2% |
| 1024x768 | 0.0% | 0.1% | 0.0% | 0.0% | 0.0% | 99.9% | 95.1% | 99.9% |
| 1920x1088 | 0.1% | 0.1% | 0.0% | 0.0% | -0.1% | 99.8% | 96.7% | 100.5% |
| **average** | **0.0%** | **0.1%** | **0.0%** | **0.0%** | **-0.1%** | **99.8%** | **96.0%** | **100.2%** |

# Conclusion

In this proposal, two simplifications have been proposed for VSP. One is disabling VSP for depth coding, and the other one is simply using NBDV instead of DoNBDV to derive a depth block for VSP. The experimental results reportedly show that both the proposed simplifications introduce no overall coding losses. The second simplification can even achieve 0.1% BD-rate savings for coded and synthesized views with reduced memory access bandwidth.

# Patent rights declaration (s)

**MediaTek Inc. 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).**

# References

1. HTM-6.0, https://hevc.hhi.fraunhofer.de/svn/svn\_3DVCSoftware/tags/HTM-6.0
2. D. Rusanovskyy, K. Müller, A. Vetro, “Common test conditions of 3DV Core Experiments,” Document of Joint Collaborative Team on 3D Video Coding Extension Development, JCT3V-C1100, January, 2013.