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| *Title:* | **3D-CE5.h: Improved temporal motion vector prediction for merge** | | |
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| *Purpose:* | Proposal | | |
| *Author(s) or Contact(s):* | Li Zhang Ying Chen Marta Karczewicz  5775 Morehouse Drive San Diego, CA 92121 USA | Tel: Email: | 1-858-651-6660 [lizhang@qti.qualcomm.com](mailto:lizhang@qti.qualcomm.com)  1-858-845-6589 [cheny@qti.qualcomm.com](mailto:cheny@qti.qualcomm.com) |
| *Source:* | Qualcomm Incorporated | | |

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# Abstract

In current 3D-HEVC, a target reference index for temporal merging candidate is set according to the neighboring prediction unit. When the target reference index corresponds to a reference picture in the same view while the motion vector of the co-located prediction unit (PU) points to an inter-view reference picture and vice versa, temporal motion vector prediction (TMVP) candidate is considered as unavailable. To address this issue, one additional target reference index is used as proposed in JCTVC-L0257, so that TMVP candidate can be supported for the above cases. The performance of the proposed method is reported in this proposal. After aligning the CTC with the latest 3D-HEVC software and 3D-HEVC specification in terms of always setting the target reference index for temporal merging candidate to 0, the proposed method shows 0.3% average bitrate saving for the all the coded views.

1. **Introduction**

In in current 3D-HTM which is based on HM6.0, when the current mode is merge, the target reference index, denoted by refIdxTarget, could be either 0 or the reference index of the left neighbouring PU. If the motion vector of co-located PU referring to an inter-view reference picture and the target reference index corresponds to a temporal reference picture, the temporal motion vector prediction (TMVP) is disabled for current PU. Similarly, when the target reference index equal to refIdxTarget corresponds to an inter-view reference picture and the motion vector of co-located PU refers to a temporal reference picture, TMVP is also disabled.

In 3D-HEVC, there might be significant amount of co-located PUs (in the co-located picture) which have a different reference picture type than that identified by the target reference index. Therefore, disabling prediction from those motion vectors makes the merge mode less efficient.

1. **Proposed Method**

During the merge mode, instead of disabling the TMVP candidate when the reference picture to which the TMVP points to and the target reference picture are from different views, the motion vector is considered as available, by associating it with a different reference index corresponding to a reference picture in the same view as TMVP points to. It was proposed in JCT3V-B0050 [1] that the target reference picture index is modified to the first entry to a reference picture list which corresponds to a reference picture in the same view as TMVP points to. In more details, the following apply:

Suppose refIdxC is the reference index corresponds to the first entry in a reference picture list which corresponds to an inter-view reference picture. refIdxD is the reference index corresponds to the first entry in a reference picture list which corresponds to a temporal reference picture. refIdxTarget is the target reference index.

The following will be applied in the proposed method:

* If RefPicListX[refIdxTarget] is a temporal reference picture and the reference picture TMVP points to was an inter-view reference picture of the co-located picture, TarIdx\_LX is set to C.
* If RefPicListX[refIdxTarget] is an inter-view reference picture and the reference picture TMVP points to was a temporal reference picture of the co-located picture, TarIdx\_LX is set to D.

Note in current 3D-HEVC specification, refIdxTarget is always equal to 0. Either refIdxC or refIdxD should be equal to 0 and the other non-zero value could be derived at slice-level.

1. **Compression Performance**

This section provides simulation results of the proposed method in comparison with the 3D-HTM anchor. Two sets of simulations have been conducted: 1) align the software with 3D-HEVC specification in terms of always setting the target reference index for temporal merging candidate to [2] ; 2) exactly the same as current 3D-HTM version 5.0.1 where the reference index from left neighbouring block may be inherited by temporal merging candidate. For both cases, the proposed method is implemented on top of 3D-HTM 5.0.1 [3] and all the simulation tests are performed based on the common test conditions [4].

Table 1 provides the results of the proposed method compared with 3D-HTM anchor with the first case. The overall average bitrate reduction is 0.3%, 0.3%, 0.3% for decoded texture views, synthesized views, and coded & synthesized views, respectively.

Table 2 provides the results of the proposed method compared with 3D-HTM anchor with the second case. The overall average bitrate reduction is 0.1%, 0.1%, 0.1% for decoded texture views , synthesized views, and coded & synthesized views, respectively.

Table 1: Coding gain of ARP with respect to anchor for 3-view case (Reference index set as that in HEVC)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Video  1 | Video  2 | Video  only | Syn.  only | Coded & synthesized | Enc  time | Dec  time | Ren  time |
| Balloons | -1.0% | -0.8% | -0.4% | -0.2% | -0.3% | 110% | 112% | 105% |
| Kendo | -1.5% | -1.2% | -0.5% | -0.5% | -0.5% | 104% | 103% | 101% |
| Newspapercc | -0.4% | -0.4% | -0.2% | -0.2% | -0.2% | 106% | 96% | 97% |
| GhostTownFly | -1.5% | -1.3% | -0.4% | -0.4% | -0.4% | 99% | 96% | 99% |
| PoznanHall2 | -0.9% | -0.8% | -0.4% | -0.3% | -0.3% | 102% | 100% | 98% |
| PoznanStreet | -0.7% | -0.9% | -0.3% | -0.2% | -0.2% | 109% | 108% | 102% |
| UndoDancer | -0.5% | -0.4% | -0.2% | -0.1% | -0.1% | 103% | 102% | 103% |
| 1024x768 | -1.0% | -0.8% | -0.3% | -0.3% | -0.3% | 107% | 103% | 101% |
| 1920x1088 | -0.9% | -0.8% | -0.3% | -0.3% | -0.3% | 103% | 101% | 100% |
| **average** | **-0.9%** | **-0.8%** | **-0.3%** | **-0.3%** | **-0.3%** | **105%** | **102%** | **101%** |

Table 2: Coding gain of ARP with respect to anchor for 3-view case (Reference index set as that in HTM)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Video  1 | Video  2 | Video  only | Syn.  only | Coded & synthesized | Enc  time | Dec  time | Ren  time |
| Balloons | -0.4% | -0.3% | -0.1% | -0.1% | -0.1% | 102% | 100% | 102% |
| Kendo | -0.6% | -0.6% | -0.3% | -0.2% | -0.2% | 98% | 97% | 100% |
| Newspapercc | -0.3% | -0.3% | -0.1% | -0.1% | -0.1% | 96% | 93% | 95% |
| GhostTownFly | -0.2% | -0.4% | -0.1% | -0.2% | -0.2% | 94% | 95% | 98% |
| PoznanHall2 | -0.3% | 0.3% | 0.0% | 0.0% | 0.0% | 100% | 106% | 98% |
| PoznanStreet | -0.4% | -0.3% | -0.1% | -0.1% | -0.1% | 92% | 96% | 95% |
| UndoDancer | -0.2% | -0.3% | -0.1% | -0.2% | -0.1% | 95% | 94% | 96% |
| 1024x768 | -0.4% | -0.4% | -0.2% | -0.1% | -0.1% | 99% | 97% | 99% |
| 1920x1088 | -0.3% | -0.2% | -0.1% | -0.1% | -0.1% | 95% | 98% | 97% |
| **average** | **-0.3%** | **-0.3%** | **-0.1%** | **-0.1%** | **-0.1%** | **97%** | **97%** | **98%** |

1. **References**
2. L. Zhang, Y. Chen, M. Karczewicz, "3D-CE5.h related: Improved temporal motion vector prediction for merge," ITU-T SG 16 WP 3 and ISO/IEC JTC 1/SC 29/WG 11, JCT3V-B0050, 2nd Meeting: Shanghai, CN, 13–19 Oct. 2012.
3. G. Tech, K. Wegner, Y. Chen, S. Yea, "3D-HEVC Test Model 2," ITU-T SG 16 WP 3 and ISO/IEC JTC 1/SC 29/WG 11, JCT3V-B1005, 2nd Meeting: Shanghai, CN, 13–19 Oct. 2012.
4. 3D-HTM version 5.0.1: <https://hevc.hhi.fraunhofer.de/svn/svn_3DVCSoftware/tags/HTM-5.0.1/>.
5. D. Rusanovskyy, K. Müller, A. Vetro, "Common Test Conditions of 3DV Core Experiments," ITU-T SG 16 WP 3 and ISO/IEC JTC 1/SC 29/WG 11, JCT3V-B1100, 2nd Meeting: Shanghai, CN, 13–19 Oct. 2012.
6. **Patent rights declaration(s)**

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