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| *Title:* | **3D-CE3.h related: Unconstrained motion parameter inheritance in 3D video coding** | | |
| *Status:* | Input Document | | |
| *Purpose:* | Proposal | | |
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# Abstract

In the HEVC-based 3D video coding, HTM 4.0.1, a motion parameter inheritance (MPI) is used to explore the correlation between the video signal and its associated depth map. When using MPI, the encoder needs to ensure that the whole region of the video signal to be inherited from is coded using inter prediction and the reference indices inherited from the video signal are also available in the reference picture buffer of the depth map coding. However, syntax wise, the encoder can still signal the MPI mode on, even though partial region is coded using intra prediction or the reference pictures are unavailable. In this case, a mismatch caused by the inconsistency of MPI might happen due to the different implementation between encoder and decoder. In this contribution, an unconstrained MPI is proposed to use a default zero motion vector for the undefined or unclear motion data. The experiment reportedly show an average 0.1% coding gain for the coded and synthesized views while the undefined decoder behavior in MPI can be solved.

# Introduction

In the HEVC-based 3D video coding, HTM v4.0.1 [1], to explore the correlation between the video signal and its associated depth map, the motion parameter inheritance (MPI) mode is employed. In order to encode the depth map efficiently, MPI allows the inheritance of the treeblock subdivision into CUs and PUs and their corresponding motion parameters from the video signal [2]. For each CU of the depth map, the encoder can adaptively decide whether the motion data are inherited from the co-located region of the video signal or if new motion data are transmitted as illustrated in Figure 1. To signal the MPI coding mode, the syntax is integrated into the merge and skip mode. The merging candidate list has been extended by adding the MPI coding mode as the first candidate in the merging candidate list for depth map coding.

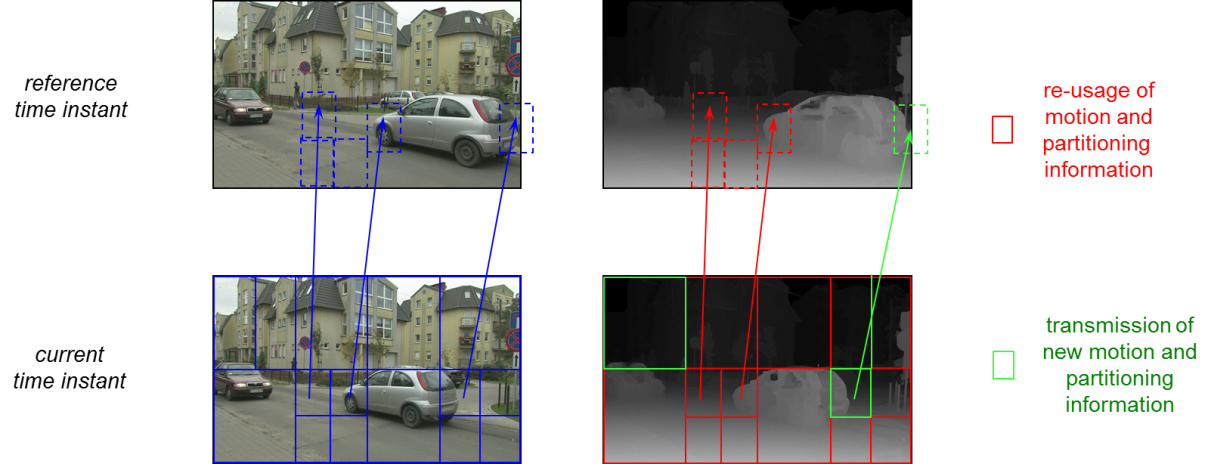


Figure 1: Illustration of the concept of motion parameter inheritance [2]

In current design, the MPI mode is only possible when the whole region of the video signal, that the motion data and partitioning are inherited from, is coded using inter prediction and the reference indices inherited from the video signal are also available in the reference picture buffer for the depth map coding. However, syntax wise, the encoder can still signal the MPI mode on, even though partial region is coded using intra prediction or the reference pictures are unavailable in the reference picture buffer. In this case, an inconsistency of MPI might happen due to the different implementation between encoder and decoder. As the result, it would be considered that a mismatch might happen in the decoded pictures. Therefore, there will be some risks that a decoder would do an unexpected behavior by using undefined or unclear values.

# Proposed Method

To avoid such a mismatch due to the different implementation on the undefined or unclear motion data (i.e., the undefined motion data for the intra coded region or the reference picture is not in the reference picture buffer) between encoder and decoder, and to prevent an unexpected behavior of decoder, we propose to use predetermined motion data for the intra coded region or the region with unavailable reference picture to eliminate the undefined decoder behavior.

In the proposed modification, when the MPI is enabled, the region with undefined or unclear motion data is filled up with motion vector equal to (0,0), reference index equal to 0, and prediction type (uni-prediction or bi-prediction) equal to slice type.

# Experimental Results

Experiments were conducted according to the common test conditions [3], and the software is based on HTM-4.0.1 [1]. In current HTM-4.0.1, when using MPI, the encoder needs to ensure that the whole region of the video signal, that the motion data and partitioning are to be inherited from, is coded using inter prediction and the reference indices inherited from the video signal are also available in the reference picture buffer for the depth map coding. In the experiment, we remove the above check on the encoder side, to let the MPI be possible even though partial region is coded using intra prediction. The results are shown in Table 1. The experiments shows that an average 0.1% BD-rate saving is achieved while the undefined decoder behavior can be solved.

**Table 1. The BD-rate result of constrained DV derivation**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Video 1 | Video 2 | Video only | Synthesized only | Coded & synthesized | Enc time | Dec time | Ren time |
| Balloons | 0.0% | 0.0% | 0.0% | 0.0% | -0.1% | 99.9% | 101.8% | 86.2% |
| Kendo | 0.0% | 0.0% | 0.0% | 0.0% | -0.1% | 104.9% | 101.4% | 88.9% |
| Newspapercc | 0.0% | 0.0% | 0.0% | 0.0% | -0.1% | 101.9% | 113.0% | 99.7% |
| GhostTownFly | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 100.1% | 98.3% | 91.1% |
| PoznanHall2 | 0.0% | 0.0% | 0.0% | 0.0% | -0.3% | 103.4% | 103.5% | 92.6% |
| PoznanStreet | 0.0% | 0.0% | 0.0% | 0.0% | -0.2% | 95.7% | 89.4% | 88.3% |
| UndoDancer | 0.0% | 0.0% | 0.0% | 0.0% | -0.1% | 96.5% | 91.1% | 83.9% |
| 1024x768 | 0.0% | 0.0% | 0.0% | 0.0% | -0.1% | 102.2% | 105.3% | 91.4% |
| 1920x1088 | 0.0% | 0.0% | 0.0% | 0.0% | -0.1% | 98.9% | 95.4% | 88.9% |
| **average** | **0.0%** | **0.0%** | **0.0%** | **0.0%** | **-0.1%** | **100.3%** | **99.5%** | **90.0%** |

# Conclusion

In this proposal, we propose to use predetermined motion data for the undefined or unclear motion data to eliminate the undefined decoder behavior. The experiments shows that an average 0.1% BD-rate saving is achieved while the undefined decoder behavior can be solved.

# 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-4.0.1, <https://hevc.hhi.fraunhofer.de/svn/svn_3DVCSoftware/tags/HTM-4.0.1/>

[2] Gerhard Tech, Krzysztof Wegner, Ying Chen, and Sehoon Yea, “3D-HEVC Test Model 1”, 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, JCT3V-A1005, July 2012, Stockholm.

[3] Dmytro Rusanovskyy, Karsten Müller, Anthony Vetro, “Common Test Conditions of 3DV Core Experiments”, 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, JCT3V-A1100, July 2012, Stockholm.