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| *Title:* | **Description of Core Experiment 5 (CE5): Motion/Mode Parameter Prediction** | | |
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# Abstract

This document defines Core Experiment 5 on motion/mode parameter prediction to be performed for the 2nd JCT-3V meeting.

# Introduction

The goal of this Core Experiment (CE) is to investigate the methods for motion/mode parameter prediction proposed at the 1st JCT-3V meeting. Tools under test will be evaluated according to their impact on compression efficiency and implementation complexity

# Participants

## CE5.a

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# Tools under Test

## CE5.a

### Improved skip and direct motion vector prediction [JCT2-A0040]

The anchor now employs a disparity vector, which is derived from the neighboring blocks or the corresponding depth blocks, to bring motion information for skip and direct motion vector from the inter-view reference frame. If the neighboring blocks do not have an inter-view motion vector, a disparity for a middle sample in the corresponding depth block is used. The proposed method, which uses a max disparity for skip and direct modes, was applied to the anchor to verify its performance.

### Depth-based motion vector prediction for asymmetric texture and depth resolutions [JCT2-A0041]

The anchor employs a disparity vector, which is derived from the neighboring blocks or the corresponding depth blocks, to bring motion information for skip and direct motion vector from the inter-view reference frame. If the adjacent blocks do not have an inter-view motion vector, a disparity is found from the corresponding block in the normalized depth image with the up-sampling. The proposed method, which employs the depth image of the quarter resolution without up-sample in the prediction, was applied to the anchor to demonstrate its performance.

## CE5.h

### Disparity vector generation results [JCT2- A0097]

In the current 3DV-HTM software, disparity vectors can be estimated by two methods, and are used for inter-view motion prediction and inter-view residual prediction. One method is to maintain a depth map for each picture of each view and the depth map is generated from disparity motion vectors and predicted by propagating the depth map to a different time instance with temporal motion vectors and propagating the depth map to a different view using view synthesis. The other method, as proposed in m24937, derives a disparity vector from spatial and temporal neighboring blocks, once a disparity motion vector in any of the blocks is identified, the disparity vector is derived. The coding efficiency of the two methods is analyzed in the latest HTM software this proposal. It is reported that deriving the disparity vector from neighbouring blocks will reduce the complexity greatly and the cost in terms of compression efficiency is negligible.

### Simplification of disparity vector derivation for HEVC-based 3D video coding [JCT2-A0126]

For inter-view motion parameter prediction and inter-view residual prediction, a disparity vector should be determined to specify a corresponding location in an inter-view reference picture. In the 100th MPEG meeting, a disparity vector derivation algorithm, which searches DCP blocks in spatial and temporal neighbour blocks, is decided to be included in the HTM s/w. This contribution proposes an efficient disparity vector derivation algorithm that reduces the number of access to temporal reference picture, and extends the source of disparity information by including DV-MCP blocks, which used a disparity vector for its inter-view motion parameter prediction. Experimental result showed that the proposed algorithm increased 0.1% BD rate for texture views and no coding performance change for synthesized views.

### Simplification of AMVP [JCT2-A0014]

This contribution presents a simplified motion vector candidate construction for AMVP. The proposed method adds zero vector to the candidate list when the inter-view candidate (derived by Inter-view motion prediction) is not available and changes the pruning combination to avoid the unnecessary candidate motion vector derivation process. It is reported that average BD-rate of the proposal is not changed from that of the anchor (HTM3.1).

### Pruning process for inter-view candidate [JCT2-A0048]

In the HEVC-based 3D video coding, a number of parallelizable motion information comparisons between the spatial merging candidates are performed for the redundancy removal in the candidate list of the merge and skip modes. This contribution proposes to make one additional parallelizable motion information comparison between the inter-view candidate and the first spatial candidate in the pruning process. This contribution also proposes to remove the check on the number of available candidates before the pruning process in the inter mode for simplification. The experimental results reportedly show BD-rate savings of 0.2% and 0.4% are achieved for texture view 1 and view 2, respectively, with this simple candidate comparison.

### Improved merge mode for inter-view predicted motion [JCT2-A0096]

When inter-view motion prediction is enabled, the current HTM design of the merging candidate list includes an inter-view candidate from a dependent view. However, an inter-view candidate might be identical to existing spatial merging candidates in the merging candidate list. It is proposed to remove duplicated motion vector candidates with one addition step of pruning. Compared to the current HTM design, the proposed method achieves compression efficiency gain of 0.2%, 0.1% and 0.1% for coded views, synthesized views, coded and synthesized view, respectively, in terms of BD rate.

### Reducing the coding cost of merge index by dynamic merge candidate list re-ordering [JCT2-A0133]

HEVC implements a candidate vector list for merge and skip modes. When merge or skip modes are selected, a merge index is written in the bitstream. This index is first binarized using a unary code, then CABAC encoded. A CABAC context is dedicated to the first bin of the unary coded index while the remaining bins are considered as equiprobable. This strategy is efficient as long as the candidate list is constructed such as being ordered by decreasing index occurrence probability. In the context of 3D video encoding, an inter-view motion vector predictor is added at the first position of the candidate list. It is reported in this document that the inter-view motion vector predictor is not always the most probable candidate. It actually depends on the video sequence characteristics. Therefore, a dynamic candidate vector list ordering is proposed. Coding gains of 0.1 % on average are observed on side views and up to 0.6% is attained for the GTFly sequence view 2.

### Merge candidate list extension for disparity compensated prediction [JCT2-A0134]

HEVC implements a candidate vector list for merge and skip modes. The construction of this list has been extensively studied in the JCT-VC group (see for instance JCTVC-G039). It has been shown in JCTVC-I0293 that it is possible to improve the HEVC coding performance by adding in the merge list copies of the first candidate shifted by an arbitrary offset. The same basis is considered in this document and applied to disparity compensation. A gain of 0.4 % is obtained on average on side views.

# Mandates

## CE5.a

One proposal by Samsung (JCT2-A0040) is on simplification of the disparity coefficient and the improvement of the skip and direct motion vector prediction. Another CE5.a related proposal by Samsung (JCT2-A0041) is on using quarter resolution of the depth map for depth-based motion vector prediction to reduce the decoder complexity.

The mandates of this core experiment are as follows:

1. Evaluate the coding efficiency of the proposals (JCT2-A0040)
2. Verify the simplification and the complexity reduced by the proposals (JCT2-A0041)

## CE5.h

The mandates of this core experiment are as follows:

1. To further investigate ways to improve NBDV for generating disparity vector in terms of coding efficiency and complexity. *[JCT2-A0097,JCT2-A0126]*

- To further evaluate the NBDV scheme in terms of complexity & memory-access requirements

1. To further investigate ways to improve Merge/AMVP-lists construction in the context of the current CE. *[JCT2-A0014,JCT2-A0048,JCT2-A0096,JCT2-A0133,JCT2-A0134]*

# Software, Configuration and Evaluation

## Software

### CE5.a

The integrated 3D-ATM which includes the adoptions in the 1st JCT-3V meeting will be used in the experiment

### CE5.h

Experiments in CE5 will use the 3D-HTM-4.0 software that is recommended in JCT2-A1100. Proponents are requested to provide software that can be compiled under Windows and Linux platforms.

## Test Sequences, Bit Rates and Coding Conditions

The CE will use the test sequences, configuration and conditions that are recommended in JCT2-A1100. Moreover, proponents and cross checkers are required to provide simulation results for the Random access configuration as specified in JCT2-A1100.

## Evaluation of CE Results

1. Measure impact on bitrate/PSNR. PSNR shall be calculated for the decoded texture views, relative to original texture views and for the synthesized views relative to uncompressed synthesized views. Use 4-point BD-PSNR and BD-Rate according to common conditions. The anchors will be generated according to common test conditions.
2. Measure impact on encoding and decoding runtimes for all test cases relative to the unmodified test model software.
3. Report comments of subjective visual quality according to common conditions.

# Timelines

## CE5.a

2012/08/31 3DV-ATM v0.4 available along with the anchor

2012/09/28 Make source code and simulation results available for cross check

2012/10/05 Register documents for the JCT-3V 2nd meeting

2012/10/08 Upload contributions to JCT-3V 2nd meeting

## CE5.h

2012/08/31 3DV-HTM v4.0 available along with the anchor

2012/09/28 Make source code and simulation results available for cross check

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2012/10/08 Upload contributions to JCT-3V 2nd meeting