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| *Title:* | **CE9 Subtests N and O: Improvement on AMVP** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Proposal | | |
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# Abstract

This contribution presents a modified Advanced Motion Vector Prediction (AMVP). In AMVP, MVs of the spatial neighboring PUs are regarded as spatial neighboring MVPs if and only if they are with the same reference index and the same reference list as the MV of the current PU. In this proposal, MVs with a different reference index or a different reference list are also considered with related scaling method. This method is also applied to the merge skip method proposed by HHI in CE9 test D (JCTVC-E029). The simulation results report that the proposed method on top of default HM 2.0 achieves average 0.5% and 0.7% bit rate reduction for RAHE and RALC, and average 0.1% for both low delay configurations. Encoding and decoding time are avg. 105% and 102% respectively. On the other hand, the proposed method on top of the merge skip method achieves 0.3% (RAHE), 0.8%(RALC), 0.6%(LDHE), -0.7%(LDHE) bit rate reductions. The average encoding and decoding time ratio are 114% and 101% respectively.

# Introduction

For the current HEVC Test Model (HM 2.0), AMVP is adopted as a method of motion vector prediction [1]. In AMVP, The motion vector predictor list, mvpListLX, is constructed of elements which are followed as {mvLeft, mvAbove, mvCol}. In JCT-VC D231 [2], the spatial predictor selection manner was improved as shown in Figure 1. The predictors are selected by matching the reference list and reference index of current coding block.

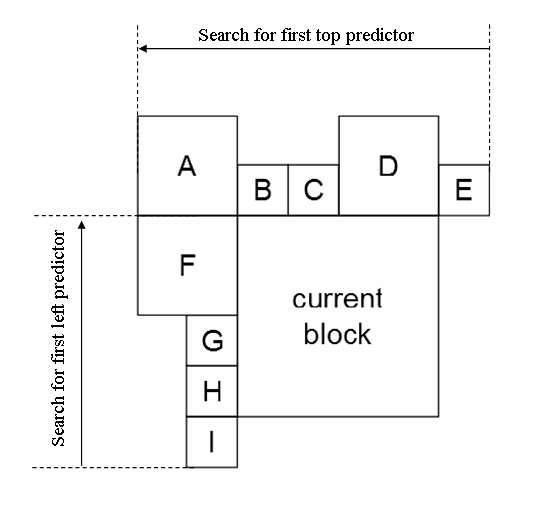


Figure 1 Search directions and range for left and top predictor

We have proposed a method for searching the motion vector predictors at Daegu meeting [3]. In the proposed method, MVs with a different reference index or a different reference list are also considered with related scaling method. In this contribution, we applied our method on top of current HM 2.0 and also applied it on top of the method in CE9 test D.

# Proposed algorithm

## Proposed method works with default AMVP in HM2.0

We propose some additional process for obtaining motion vector predictors {mvLeft, mvAbove}. In the proposed method, it is scanned and checked if there is a neighboring MV which satisfies each following condition in order.

1. same reference picture and same reference list (with those of current prediction unit)
2. same reference picture and different reference list
3. different reference picture and same reference list
4. different reference picture and different reference list

The first available MV along the search direction is chosen in the above process. And then, the chosen MV is scaled by a factor of (tb / td), and inverted if its prediction direction is different from that of current MV, as figure 2 shows.

Figure 2 The example for MV scaling

The condition 1 represents original AMVP method. And the condition 2, 3 and 4 are added parts in this proposal.

## Proposed method works with the method in CE9 test D

In [4], a method has been proposed to use merge mode to replace skip mode and use merge candidates to replace the AMVP candidates, in which the above search scheme in [2] is avoid. The merge mode and regular inter mode share the same motion vector candidates derivation scheme. Our proposed method is applied to this unification for regular inter modes, the motion vector predictor will be obtained by checking the fixed neighboring blocks as shown in Figure 3.



Figure 3 Merge candidate blocks

The proposed method for this case is

1. same prediction mode (uni or bi pred), same reference picture and same reference list
2. same reference picture and same reference list (with those of current prediction unit)
3. same reference picture and different reference list
4. different reference picture and same reference list
5. different reference picture and different reference list

In each step, the left, above, and corner candidates will be checked. Once the max candidate number allowed is matched, the remaining steps will be skipped.

The condition 2 represents original AMVP method. And the condition 1, 3, 4, and 5 are added parts in this proposal.

# Experimental results

## Proposed method works with default AMVP in HM2.0: CE9 test N

The proposed method is implemented on HM 2.0 software and simulated under the common test conditions. And the performance is compared in terms of Bjøntegaard Delta (BD) Bit Rate [4]. Table 1 summarizes the experimental results. This results are cross-checked by MediaTek.

Table 1 Proposed method works with default AMVP in HM2.0

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Configuration | BD rate saving (%) | | | Complexity | |
| Y | U | V | Encoder | Decoder |
| HE Random Access | -0.5 | -0.6 | -0.7 | 104% | 101% |
| LC Random Access | -0.7 | -0.7 | -0.7 | 104% | 102% |
| HE Low Delay | -0.1 | 0.1 | 0.0 | 105% | 101% |
| LC Low Delay | -0.1 | 0.0 | 0.1 | 107% | 102% |

## Proposed method works with the method in CE9 test D: CE9 test O

The proposed method is implemented on top of HHI’s proposal [4] and simulated under the common test conditions. In this software, the setting is same as CE9 test D. And the performance is compared to HM2.0 anchor in terms of Bjøntegaard Delta (BD) Bit Rate [5]. Table 2 summarizes the experimental results.

Table 2 Proposed method applied to method in [4]

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Configuration | CE9 test D | | | CE9 test D + proposed | | |
| Y | U | V | Y | U | V |
| HE Random Access | 0.0 | -0.1 | 0.0 | -0.3 | -0.4 | -0.4 |
| LC Random Access | -0.3 | -0.2 | -0.2 | -0.8 | -0.8 | -0.7 |
| HE Low Delay | -0.6 | 0.0 | -0.2 | -0.6 | 0.1 | 0.0 |
| LC Low Delay | 0.8 | 0.5 | 0.5 | 0.7 | 0.4 | 0.3 |

Table 3 Complexity measurment of the proposed method on top of [4]

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Configuration | CE9 test D | | CE9 test D + proposed | |
| Encoder | Decoder | Encoder | Decoder |
| HE Random Access | 99% | 100% | 112% | 101% |
| LC Random Access | 98% | 100% | 116% | 101% |
| HE Low Delay | 98% | 100% | 111% | 101% |
| LC Low Delay | 98% | 98% | 117% | 100% |

# Conclusion

In this contribution, an improved method for obtaining motion vector predictors on AMVP was presented by considering prediction mode, different reference list, and different reference index. The proposed method with default AMVP produces 0.5% and 0.7% BD bit rate reduction under RAHE and RALC, and 0.1% for low-delay configurations. The method can also works with the unified solution defined in CE9 test D. In that case, the proposed method produces 0.3% (RAHE), 0.8%(RALC), 0.6%(LDHE), -0.7%(LDLC) bit rate reductions. We propose to adopt our method into HM.

# Patent rights declaration(s)

**LG Electronics and Qualcomm may have IPR 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).**

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