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| *Title:* | **On the reference picture comparison for boundary strength** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Proposal | | |
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# Abstract

Current condition checking for deciding boundary strength for deblocking process involves motion vectors and reference pictures. Implementation for this part may be complicated for blocks that the boundary of slices since reference picture lists can be different for each slice in a picture due to reference picture list reordering possibility. Furthermore, it is also suggested that current condition checking for boundary decision may not be accurate if weighted prediction is used.

This contribution proposed two options to handle the above issues:

Option 1: to remove the reference picture comparison from the condition when deciding boundary strength for deblocking process to reduce the problem of list reordering at the boundary of slice. It showed negligible in BD-rate under Random access condition and small gains under low delay condition. It also showed no difference in subjective quality.

Option 2: if option 1 is not desired and the checking still has to involve reference pictures, possibility of different weighted prediction value should be taken into consideration as well.

# Introduction

In the current HEVC, the boundary strength is decided by prediction modes of two blocks and their motion vectors and reference pictures when available. Fig. 1 shows the decision tree of the boundary strength.

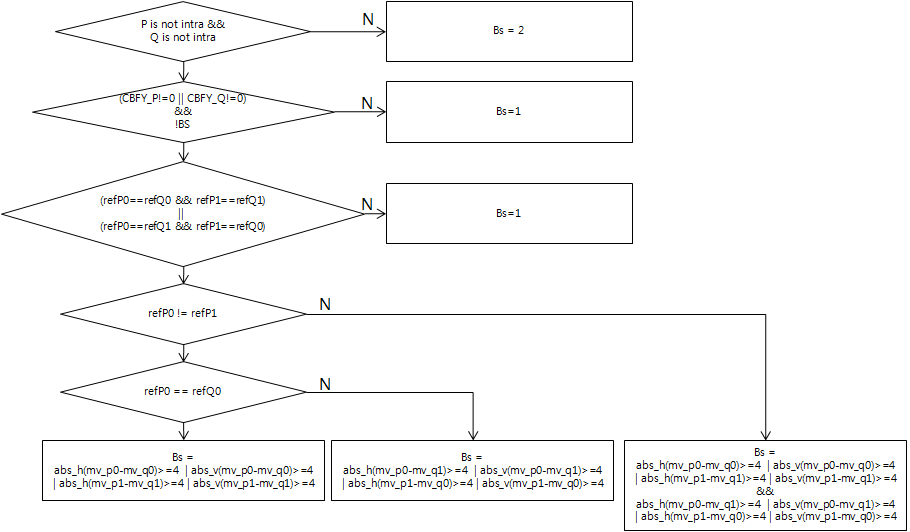


Fig. the decision tree of the boundary strength

In Fig. 1 abs\_h(.) indicates absolute difference of motion vectors in horizontal and abs\_v(.) indicates absolute difference of motion vectors in vertical. refP0, refP1, refQ0 and refQ1 indicate the reference pictures of corresponding block P and Q. If block P and block Q locate in separate slices reference lists for each slice could be different. Therefore it requires the process for identifying the reference picture number itself from the lists.

# Proposed Methods

## Removing reference pictures from the decision tree

We propose to remove the comparison of reference picture in the decision tree. The absolute differences of motion vectors in list0 and motion vector in list1 is use to decide the boundary strength. Therefore the decision tree is simplified as below.

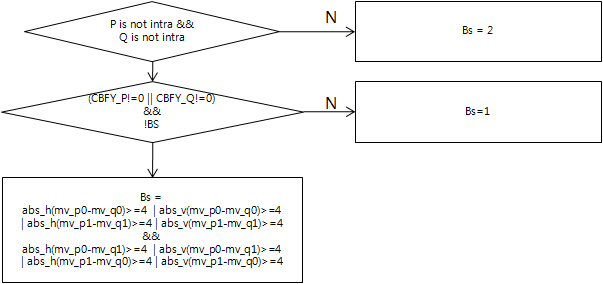


Fig. the decision tree of the boundary strength

In this case it is not required to compare the reference pictures of two blocks. It would release the burden of check the reference list and mapping actual reference pictures to the reference indices.

## Taken weighted prediction into BS decision tree

The decision tree shown in Fig. 1 does not consider the possibility of motion vectors / reference pictures having different weight for prediction. Thus, if weighted prediction is in used, the above decision tree might need to be corrected to improve its performance.

We propose that if the solution in 2.1 is not desired and the checking still has to involve reference pictures, possibility of different weighted prediction value should be taken into consideration as well.

# Experimental Results

The experimental results for proposed solution in 2.1 are shown in Table 1. The proposed method is implemented on the top of HM7.0. Detailed results are described in the accompanied excel file. It shows no difference in BD-rate as in Table 1. It also shows very small gain under the condition of LBMAIN and LBHE10. It does not impact much on the subjective qualities.

Table the BD rate of the proposed method under the common condition

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Random Access Main** | | | **Random Access HE10** | | |
|  | Y | U | V | Y | U | V |
| Class A | 0.0% | -0.1% | -0.1% | 0.0% | -0.2% | 0.2% |
| Class B | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Class C | 0.0% | 0.1% | 0.0% | 0.0% | 0.0% | 0.0% |
| Class D | 0.0% | 0.0% | 0.0% | 0.0% | 0.1% | 0.0% |
| Class E |  |  |  |  |  |  |
| **Overall** | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
|  | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Class F | 0.0% | 0.1% | 0.1% | 0.0% | 0.0% | 0.0% |
| Enc Time[%] | #NUM! | | | #NUM! | | |
| Dec Time[%] | #NUM! | | | #NUM! | | |
|  |  |  |  |  |  |  |
|  | **Low delay B Main** | | | **Low delay B HE10** | | |
|  | Y | U | V | Y | U | V |
| Class A |  |  |  |  |  |  |
| Class B | 0.0% | 0.1% | -0.2% | -0.1% | 0.0% | 0.1% |
| Class C | 0.0% | -0.1% | 0.0% | -0.1% | -0.2% | 0.0% |
| Class D | -0.1% | 0.3% | 0.5% | -0.1% | -0.1% | 0.1% |
| Class E | -0.1% | -0.2% | -0.3% | -0.1% | 0.0% | 0.1% |
| **Overall** | -0.1% | 0.0% | 0.0% | -0.1% | -0.1% | 0.0% |
|  | -0.1% | 0.1% | 0.0% | -0.1% | 0.0% | 0.1% |
| Class F | -0.1% | 0.0% | 0.2% | 0.1% | 0.0% | 1.2% |
| Enc Time[%] | #NUM! | | | #NUM! | | |
| Dec Time[%] | #NUM! | | | #NUM! | | |

# Working Draft



#### Derivation process of boundary filtering strength

* + - If ~~one or more~~ all of the following conditions are true, the variable bS[ xDi ][ yDj ] is set equal to 1.
    - ~~For the prediction of the luma prediction block containing the sample p~~~~0~~ ~~different reference pictures or a different number of motion vectors are used than for the prediction of the luma prediction block containing the sample q~~~~0~~~~.~~

NOTE 1 – The determination of whether the reference pictures used for the two luma prediction blocks are the same or different is based only on which pictures are referenced, without regard to whether a prediction is formed using an index into reference picture list 0 or an index into reference picture list 1, and also without regard to whether the index position within a reference picture list is different.

NOTE 2 – The number of motion vectors that are used for the prediction of a luma prediction block with lop left luma sample covering ( xB, yB ), is equal to PredFlagL0[ xB, yB ] + PredFlagL1[ xB, yB ].

* + - ~~One motion vector is used to predict the luma prediction block containing the sample p~~~~0~~ ~~and one motion vector is used to predict the luma prediction block containing the sample q~~~~0~~ ~~and the absolute difference between the horizontal or vertical component of the motion vectors used is greater than or equal to 4 in units of quarter luma frame samples.~~
    - ~~Two motion vectors and two different reference pictures are used to predict the luma prediction block containing the sample p~~~~0~~ ~~and two motion vectors for the same two reference pictures are used to predict the luma prediction block containing the sample q~~~~0~~ ~~and the absolute difference between the horizontal or vertical component of the two motion vectors used in the prediction of the two luma prediction blocks for the same reference picture is greater than or equal to 4 in units of quarter luma frame samples,~~
    - ~~Two motion vectors for the same reference picture are used to predict the luma prediction block containing the sample p~~~~0~~ ~~and two motion vectors for the same reference picture are used to predict the luma prediction block containing the sample q~~~~0~~ ~~and all of the following conditions are true:~~
    - The absolute difference between the horizontal or vertical component of list 0 motion vectors used in the prediction of the two luma prediction bocks is greater than or equal to 4 in quarter luma frame samples or the absolute difference between the horizontal or vertical component of the list 1 motion vectors used in the prediction of the two luma prediction blocks is greater than or equal to 4 in units of quarter luma frame samples,
    - The absolute difference between the horizontal or vertical component of list 0 motion vector used in the prediction of the luma prediction block containing the sample p0 and the list 1 motion vector used in the prediction of the luma prediction block containing the sample q0 is greater than or equal to 4 in units of quarter luma frame samples or the absolute difference between the horizontal or vertical component of the list 1 motion vector used in the prediction of the luma prediction block containing the sample p0 and list 0 motion vector used in the prediction of the luma prediction block containing the sample q0 is greater than or equal to 4 in units of quarter luma frame samples.
    - Otherwise (none of the conditions above is true), the variable bS[ xDi ][ yDj ] is set equal to 0.

# References

1. F. Bossen, “*Common HM test conditions and software reference configurations*”, JCTVC-I1100, 9th JCT-VC Meeting, Geneva, Switzerland, May. 2012.

# Patent rights declaration(s)

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