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| *Title:* | **Improvement on illumination compensation reference pixels selection** | | | |
| *Status:* | Input Document | | | |
| *Purpose:* | Proposal | | | |
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# Abstract

This contribution proposes an improvement of illumination compensation reference pixels selection. To take more partition cases into consideration, the performance of simplified DC prediction is further improved in this contribution. It is reported that -0.1% BD-rate gain is achieved for view2 and synthesized view under CTC.

# Introduction

A linear illumination compensation model is utilized to adapt luminance and chrominance of inter-view predicted blocks to the illumination of the current view. The parameters (including scaling factor *a* close to 1 and an offset *b*) of the linear model are estimated for each CU using reconstructed neighboring samples of the current block and of the reference block used for prediction. The corresponding neighboring samples in the reference view are identified by the disparity motion vector of the current PU, as shown in Figure 1.



Figure 1 Neighbouring samples for the derivation of illumination compensation parameters.

For the current PU, its neighboring samples, which indicated by yi for i = 0..N-1, together with the corresponding neighboring samples of the reference block, which indicated by xi for i = 0..N-1, are the input parameters for a linear model to derive *a* and an offset *b* by a least squares solution wher the following equation E (*a*, *b*) is minimized:

|  |  |  |
| --- | --- | --- |
|  | E (*a*, *b* ) = | () |

To further simplify the IC process, illumination compensation parameters are derived from a neighboring sample array decimated by a factor of 2 and illumination compensation is disabled for 4x4 chroma blocks. Moreover illumination compensation is only applied for coding blocks with a partition mode of 2Nx2N.

However, the reference pixels may not aligned well when the DV is not accurate enough as shown in Figure 2 with 1 pixel misalignment. This makes the IC parameter derivation less accurate.



Figure 2. Example of less accurate IC parameter derivation with reference pixels misaligned (Red Pixels pairs are used for IC parameter calculation)

# Proposed solution

To derive more accurate IC parameters, we propose a IC reference pixel refinement algorithm as follows:



Figure 3. An example of the proposed algorithm(Red Pixels pairs are used for SAD calculation)

We calculate the SAD of three pairs of reference pixels, as show in Figure 3, with equations (1) (2) (3), and selected the pair with minimal SAD as reference pixels for IC parameter derivation.

(1)

(2)

(3)

Where N is the length of the PU size, ***yn*** is the pixel located at position **n** of reference neighboring blocking, and ***xn*** is the pixel located at position **n** of reconstructed neighboring blocking.

The proposal IC reference pixels selection algorithm is only applied for PU size smaller than or equal to 16x16.

# Experimental results

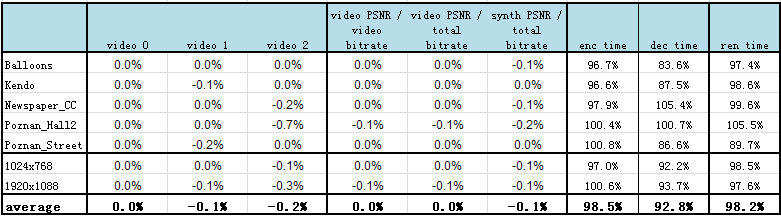
The proposed method is implemented on top of HTM-10.0r1, and simulations were performed under both “common test condition” [1] and configurations.

The results are summarized in Table 1. As it is reported, the proposed method achieves -0.1% BD-rate coding gain on both view 2 and synthesized view under CTC. The results for nature video under CTC are summarized in Table2.

Table 1: BD rate results for 3-view case under CTC



Table 2: BD rate results for 3-view case under CTC for nature/Camera video



# References

1. D. Rusanovskyy, K. Müller, A. Vetro, “Common Test Conditions of 3DV Core Experiments,” JCT3V-G1100, San Jose, USA, 11 Jan. – 17 Jan. 2014
2. G. Tech, K. Wegner, Y. Chen, S. Yea “Test Model 7 of 3D-HEVC and MV-HEVC” in JCT3V-G1005, San Jose, USA, 11 Jan. –17 Jan. 2014.

# Change in WD

**I.8.5.3.3.6.2 Derivation process for illumination compensation parameters**

Inputs to this process are:

* a list curSampleList specifying the current samples,
* a list refSampleList specifying the reference samples,
* a variable numSamples specifying the number of elements in curSampleList and refSampleList,
* a bit depth of samples, bitDepth,
* the size of the current luma coding block nCSl.

Outputs of this process are:

* a variable icWeight specifying a weight for illumination compensation,
* a variable icOffset specifying a offset for illumination compensation,

The variable precShift is set equal to Max( 0, bitDepth − 12 ).

When numSamples is less than or equal to 16

* + The variables sumDelta1, sumDelta2, sumDelta3 are set equal to 0 and the following applies for i ranging from 0 to numSamples / 2− 1, inclusive:

sumDelta1+= abs(refSampleList[ 2 \* i ] - curSampleList[ 2 \* i ])

sumDelta2+= abs(refSampleList[ 2 \* i +1] - curSampleList[ 2 \* i ])

sumDelta3+= abs(refSampleList[ 2 \* i ] - curSampleList[ 2 \* i + 1 ])

* + - When sumDelta1 is larger than sumDelta2 && sumDelta3 is larger than or equals to sumDelta2
      * + the following applies for i ranging from 0 to numSamples / 2− 1, inclusive:

refSampleList[ 2 \* i ] = refSampleList[ 2 \* i +1]

* + - When sumDelta1 is larger than sumDelta3 && sumDelta2 is larger than sumDelta3
      * + the following applies for i ranging from 0 to numSamples / 2− 1, inclusive:

curSampleList [ 2 \* i ] = curSampleList [ 2 \* i +1]

The variables sumRef, sumCur, sumRefSquare and sumProdRefCur are set equal to 0 and the following applies for i ranging from 0 to numSamples / 2− 1, inclusive:

sumRef += refSampleList[ 2 \* i ] (H‑198)

sumCur += curSampleList[ 2 \* i ] (H‑199)

sumRefSquare += ( refSampleList[ 2 \* i ] \* refSampleList[ 2 \* i ] ) >> precShift (H‑200)

sumProdRefCur += ( refSampleList[ 2 \* i ] \* curSampleList[ 2 \* i ] ) >> precShift (H‑201)

The variable avgShift and avgOffset are derived as follows:

avgShift = Log2( numSamples / 2) (H‑202)

avgOffset = 1 << ( avgShift − 1 ) (H‑203)

The variables numerDiv and denomDiv are derived as follows:

denomDiv= ( ( sumRefSquare + ( sumRefSquare >> 7 ) )  <<  avgShift )  
  – ( sumRef \* sumRef ) >> precShift (H‑204)

numerDiv= Clip3( 0, 2 \* denomDiv, ( ( sumProdRefCur + ( sumRefSquare >> 7 ) )  <<  avgShift )  
  – ( sumRef \* sumCur ) >> precShift ) (H‑205)

The variables shiftNumer and shiftDenom are derived as follows:

shiftDenom = Max( 0, Floor( Log2( Abs( denomDiv ) ) ) − 5 ) (H‑206)

shiftNumer = Max( 0, shiftDenom − 12 ) (H‑207)

The variables sNumerDiv and sDenomDiv are derived as follows:

sDenomDiv = denomDiv >> shiftDenom (H‑208)

sNumerDiv = numerDiv >> shiftNumer (H‑209)

The value of variable divCoeff is derived from Table H‑8 depending on sDenomDiv and the variables icWeight, and icOffset are derived as follows:

icWeight = ( sNumerDiv \* divCoeff ) >> ( shiftDenom – shiftNumer + 10 ) (H‑210)

icOffset = ( sumCur – ( ( icWeight \* sumRef ) >> 5 ) + avgOffset ) >> avgShift (H‑211)

**Table H‑8 – Specification of divCoeff depending on sDenomDiv**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **sDenomDiv** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| **divCoeff** | 0 | 32768 | 16384 | 10923 | 8192 | 6554 | 5461 | 4681 | 4096 | 3641 | 3277 | 2979 | 2731 |
| **sDenomDiv** | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| **divCoeff** | 2521 | 2341 | 2185 | 2048 | 1928 | 1820 | 1725 | 1638 | 1560 | 1489 | 1425 | 1365 | 1311 |
| **sDenomDiv** | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 |
| **divCoeff** | 1260 | 1214 | 1170 | 1130 | 1092 | 1057 | 1024 | 993 | 964 | 936 | 910 | 886 | 862 |
| **sDenomDiv** | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 |
| **divCoeff** | 840 | 819 | 799 | 780 | 762 | 745 | 728 | 712 | 697 | 683 | 669 | 655 | 643 |
| **sDenomDiv** | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 |  |
| **divCoeff** | 630 | 618 | 607 | 596 | 585 | 575 | 565 | 555 | 546 | 537 | 529 | 520 |  |

# Patent rights declaration(s)

**HiSilicon Technologies, Santa Clara University and Huawei Technologies 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).**