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| *Title:* | **CE5.h The results on simplified illumination compensation** | | |
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| *Purpose:* | Proposal | | |
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# Abstract

In the 3rd JCT-3V meeting, an offset model for Illumination Compensation(IC) was proposed to simplify the IC process. The offset model requires no multiplication in the parameter estimation/prediction process while retaining comparable coding efficiency with the linear model. In this proposal, results of the simplified IC using the offset model both for texture and depth coding is presented. It has BD-rate change 0.0% compared to current IC model on video only result with 100.3% encoding time, and 98.0% decoding time.

# Introduction

In JCV3V-B0045[2], linear model compensation was applied to correct inter-view luminance / chrominance mismatches. When the IC flag on CU was turned on, each pixel on disparity compensated block were compensated the below equations.

Where, is compensated prediction samples in a block and is prediction samples in a block before compensation is applied.

Parameter can be derived from reconstructed samples around ,. Both encoder and decoder should solve the linear least square equations to estimate . The below equations presents the linear least square solution. To reduce computing complexity, the division was replaced by multiplication, shift, and look-up-table. But, It has still multiplications of arbitrary sample values for computing cross-correlation of samples.

Where, , are left and top neighbor pixels by ,, respectively.

In JCT3V-C0046[1], the IC on depth was adopted to compensate mismatches on inter-view depth map. The result shows IC can have benefit for inter-view depth coding.

# Proposed Method

For the complexity reduction of current IC, Only offset model is applied to compensate luminance/chrominance mismatches. IC can be carried out using only additions and shifts without multiplications. The compensation model is just adding an offset as the below equation.

The parameter can be calculated by the below equation.

There are some coding loss on the average with respect to reduce the estimation order. However, It has the advantage removing multiplications of arbitrary numbers on IC process.

Moreover, the process of motion estimation is calculated by Mean Removed SAD(MR-SAD). The search method is matched with offset model rather than linear model.

In this CE contribution, the offset model of IC is applied also on depth map.

# Experimental results

The offset model is integrated into HTM-6.0. The configuration of common test condition is applied. Table1 and Table2 reportedly shows the experimental results. The simplification method is applied on texture, depth and texture & depth, respectively.

Table1. results on simplified method on only texture & depth



Although the complexity is reduced, there is coding gain in some cases, especially Poznan\_Hall2 video2.

# Complexity Analysis

Table4. comparison of operation number of current and proposed IC (per pixel)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Prediction step | Current IC | | | Proposed IC | | |
| Mul | Add | Shift | Mul | Add | Shift |
| Calculation of and for one block | ~=4·*N* +6 | ~=8·*N* +4 | ~=6 | 0 | ~=4·*N* +1 | ~=1 |
| Prediction for each pixel | 1 | 1 | 1 | 0 | 1 | 1 |
| Total operation number for each pixel prediction | 1+4/ *N +*6/ *N2* | 1+8/ *N +4*/ *N2* | 1+6/ *N2* | 0 | 1+4/ *N +*1/ *N2* | 1+1/*N2* |

Table5. comparison of operation number of current and proposed IC (16x16 block example )

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Prediction step | Current IC | | | Proposed IC | | |
| Mul | Add | Shift | Mul | Add | Shift |
| Calculation of and for 16x16 block | ~=70(34) | ~=132 | ~=6 | 0 | ~=64 | ~=1 |
| Prediction for each pixel | 1 (1) | 1 | 1 | 0 | 1 | 1 |
| Total operation number for a 16x16 block | 71(35) | 133 | 7 | 0 | 65 | 2 |

\* The numbers (\*) are the multiplications of cross-correlation (arbitrary samples)

Multiplication is not used for IC. And, the number of addition & shift can be reduced by around half.

The parameter estimation which is normative process can be calculated within 16 bit operation while the conventional linear model use 32 bit operation. Because the correlation between samples increase the operation range as well as the operation complexity.

# Conclusion

In this contribution, a method to use simple offset model is proposed to simplify IC process. The current method for IC is relatively complex because the process contains multiplications of arbitrary samples. In this proposal, the process to calculate least square solution is replaced with the calculation of the difference of mean values. The proposed method has the benefits of multiplication-free and matching with RD-metric. The result reportedly shows the simplified method has negligible change on the average coding result.

It is recommended that proposed method is adopted into 3D-HEVC.

# Reference

1. J. Jung, H. Liu*, etc.*, (LG), "Non-CE Simplification of Illumination Compensation", Joint Collaborative Team on 3D Video Coding Extension Development (JCT-3V) of ITU-T VCEG and ISO/IEC MPEG JCT3V-C0111, Geneva, Switzerland, January, 2013
2. H. Liu, J. Jung, J. Sung*, etc.*, (LG), "3D-CE2.h : Results of Illumination Compensation for Inter-View Prediction", Joint Collaborative Team on 3D Video Coding Extension Development (JCT-3V) of ITU-T VCEG and ISO/IEC MPEG JCT3V-B0045, Shanghai, China, October, 2012.
3. H. Liu, J. Jung, J. Sung*, etc.*, (LG), "CE5.h related : Bug Fix and Extension of Illumination Compensation", Joint Collaborative Team on 3D Video Coding Extension Development (JCT-3V) of ITU-T VCEG and ISO/IEC MPEG JCT3V-C0046, Geneva, Switzerland, January, 2013.

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