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| *Title:* | **CE4: Illumination compensation regression improvement and simplification** | | |
| *Status:* | Input Document to JCT-3V | | |
| *Purpose:* | Proposal | | |
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# Abstract

This contribution presents a report of CE4 Test1.1 of illumination compensation. Test 1.1 consists of two parts, simplification and improvement. Simplification is achieved by constant shift and removal of two log2 operation. Improvement is achieved by more robust parameter derivation.

The experimental result reportedly shows 0.2 % gain in video, total video and synthesis respectively.

# Introduction

Illumination compensation uses many adaptive shift and Log2 operations, which is not appropriate for implementation. So we provide constant shift operation and removal of most of Log2 operation.

And the current illumination utilizes linear model, y = a \* x + b , but sometimes it is inferior to offset model, y = x + b because the parameter is not robust. Therefore we propose to include regression cost to secure robustness and achieve higher coding gain.

# Proposal

## Regression improvement

We propose to add the regression cost in the error function E (a, b )

E (a, b ) =

If we utilized the parameter costs where parameter a should be near 1, we can get more robust prediction parameters.

The following is the normal equation with

Then parameter a is solved with

In this proposal, is set equal to



## Simplification

**Constant shift**

We propose to replace adaptive shift with constant shift (5 bit shits). This change also includes simplification of the IC parameter derivation process by removing a complex decIcShift operation which is applied on the condition that an intermediate value invPsIcWeight is less than −26 or greater than or equal to 26.

**Removal of log2 operation**

We propose to remove two Log2 operations highlighted as Yellow.

replace

* 1. ~~psShiftNumer = Max( 0, Floor( Log2( Abs( numerDiv ) ) ) − 14) (‑184)~~

with

* 1. psShiftNumer = Max( 0, psShiftDenom − 12) (‑184)

~~The variable icWeight specifying a weight for illumination compensation with 7 bit precision is derived as specified in the following:~~

* + ~~If invPsIcWeight is greater than or equal to −2~~~~6~~ ~~and less than 2~~~~6~~~~, the following applies.~~
    - 1. ~~icWeight = invPsIcWeight (‑192)~~
  + ~~Otherwise, ( invPsIcWeight is less than −2~~~~6~~ ~~or greater than or equal to 2~~~~6~~ ~~), the following applies.~~
    - 1. ~~decIcShift = Max( 0, Floor(Log2( Abs( icWeight ) ) − 5 ) ) (‑193)~~
      2. ~~[Ed (GT): In software a function counting leading zero ones is utilized to derive decIcShift. Does this match with draft text?]~~
      3. ~~icWeight = invPsIcWeight >> decIcShift (‑194)~~
      4. ~~icShift −= decIcShift~~ (‑195)

# Simulation results

Table 1 CE4 test1.1 results

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | video 0 | video 1 | video 2 | video PSNR / video bitrate | video PSNR / total bitrate | synth PSNR / total bitrate | enc time | dec time | ren time |
| Balloons | 0.0% | -1.0% | -0.9% | -0.4% | -0.3% | -0.2% | 100.5% | 102.9% | 101.1% |
| Kendo | 0.0% | -0.7% | -1.7% | -0.5% | -0.4% | -0.3% | 100.4% | 100.0% | 101.0% |
| Newspaper\_CC | 0.0% | -0.1% | -0.8% | -0.2% | -0.1% | -0.4% | 100.9% | 101.4% | 100.8% |
| GT\_Fly | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 100.6% | 99.0% | 99.9% |
| Poznan\_Hall2 | 0.0% | -1.0% | -1.7% | -0.6% | -0.5% | -0.3% | 100.8% | 99.9% | 99.8% |
| Poznan\_Street | 0.0% | 0.0% | -0.6% | -0.1% | -0.1% | 0.0% | 100.4% | 100.1% | 100.2% |
| Undo\_Dancer | 0.0% | 0.0% | -0.1% | 0.0% | 0.0% | 0.0% | 101.3% | 100.4% | 99.8% |
| 1024x768 | 0.0% | -0.6% | -1.1% | -0.3% | -0.3% | -0.3% | 100.6% | 101.4% | 101.0% |
| 1920x1088 | 0.0% | -0.2% | -0.6% | -0.2% | -0.2% | -0.1% | 100.8% | 99.8% | 99.9% |
| **average** | **0.0%** | **-0.4%** | **-0.8%** | **-0.2%** | **-0.2%** | **-0.2%** | **100.7%** | **100.5%** | **100.4%** |

# Complexity assessment

Table 3 and Table 4 shows the complexity assessment results of HTM70 and proposal, respectively. The data is the number of operations and calculated based on CE4 complexity assessment template.

Compared with Table 3 and Table 4, it is shown that the 85% of ShiftA operation, which means adaptive shift is changed to ShiftC operation, which means constant shift. And Log2 operation decreased by two-thirds (from 9 to 3).

Table 3. Number of operations of HTM70

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Summary |  | Comparison | Add/Sub | Mul | ShiftC | ShiftA | Clip | Div | Table | Log2 |
| 8x8CU |  | 36 | 266 | 172 | 0 | 123 | 99 | 0 | 3 | 9 |
| 16x16CU |  | 9 | 171 | 131 | 0 | 103 | 97 | 0 | 1 | 2 |
| 32x32CU |  | 2 | 131 | 113 | 0 | 98 | 96 | 0 | 0 | 1 |
| 64x64CU |  | 1 | 113 | 104 | 0 | 96 | 96 | 0 | 0 | 0 |

Table 4. Number of operations of Proposal (test 1.1)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Summary |  | Comparison | Add/Sub | Mul | ShiftC | ShiftA | Clip | Div | Table | Log2 |
| 8x8CU |  | 24 | 257 | 175 | 105 | 21 | 99 | 0 | 3 | 3 |
| 16x16CU |  | 6 | 168 | 132 | 98 | 5 | 97 | 0 | 1 | 1 |
| 32x32CU |  | 2 | 130 | 113 | 97 | 1 | 96 | 0 | 0 | 0 |
| 64x64CU |  | 0 | 113 | 104 | 96 | 0 | 96 | 0 | 0 | 0 |

# Conclusion

This contribution presents a report of CE4 Test1.1 of illumination compensation. The experimental result reportedly shows 0.2 % gain in video, total video and synthesis respectively. Complexity assessment results shows that 85% of adaptive shift operation is replaced by constant shift operation and 3/2 of Log2 operation is removed by the proposal.

# References

[1] T. Ikai, “3D-CE5.h related: Illumination compensation regression improvement and simplification” JCT3V-D0061, JCT3V 4th Meeting: Incheon, KR, 20–26 Apr. 2013

[2] T. Ikai, “CE4-related: Resampling in IC parameter derivation and 4x4 Chroma removal” JCT3V-E0056, JCT3V 5th Meeting: Vienna, AT, 27 July – 2 Aug. 2013

# Patent rights declaration(s)

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