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| *Title:* | **CE10.3: Simplification of First Delta Calculation in Deblocking by SKT/SKKU** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Proposal | | |
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# Abstract

This contribution addresses simplification of the deblocking filter in two ways. The first way is to use a simpler luma weak filter for calculating the first delta value. The second one is unification of the luma and chroma filters by using the same filter for the first delta calculation for luma weak filter and chroma filter. Simulation results show that the BD-rate results and subjective quality are similar to the HM5.0 anchor.

# Introduction

The current HM5.0 uses different types of deblocking filter for luma weak filter and chorma filter.

The following is the first delta calculation of luma weak filter in deblocking in the HM5.0.

* For the first pixel

Δ = Clip( –tc, tc, (( 9ⅹ(q0 – p0) – 3ⅹ(q1 – p1) + 8) / 16))

p0’ = p0 + Δ

q0’ = q0 – Δ

The following is the delta calculation of chroma filter in deblocking in the HM5.0.

* For the first pixel

Δ = Clip( –tc, tc, (( 4ⅹ(q0 – p0) – (q1 – p1) + 4 ) / 8))

p0’ = p0 + Δ

q0’ = q0 – Δ

# Proposed encoder description

Based on the previous contribution [1], this contribution addresses simplification of the deblocking filter in two ways. The first benefit of the proposed method is to simplify the luma weak filter for calculating the first delta value as follows:

The following is the first delta calculation of luma weak filter in deblocking in this proposal.

* For the first pixel

Δ = Clip( –tc, tc, (( 4ⅹ(q0 – p0) – (q1 – p1) + 4 ) / 8))

p0’ = p0 + Δ

q0’ = q0 – Δ

The first delta calculation of the proposed luma weak filter is same as the chroma filter in HM5.0. Compared to the current luma weak filter in HM5.0, the chroma filter shows similar deblocking performance with reduced calculation (i.e., saving one multiplication with 3). The second benefit is the unification of the luma and chroma filters by using the same filter for the first delta calculation for luma weak filter and chroma filter. In hardware implementation, this method leads to the simplified implementation by sharing same logic for luma weak filter and chroma filter.

# Experimental results

The proposed method is implemented on HM5.0 software [2]. Table 1 shows the summarized results of the proposed method compared to the HM5.0 anchor. The simulations are performed under the common test conditions in JCTVC-G1200 [3]. Detailed results are included in *JCTVC-H0155.xls*.

Table 1. Experimental results of the proposed method compared to the HM5.0 anchor

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | All Intra HE | | | All Intra LC | | |
| Y | U | V | Y | U | V |
| Class A | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Class B | 0.0% | 0.0% | 0.0% | -0.1% | 0.0% | 0.0% |
| Class C | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Class D | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Class E | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| **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% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Enc Time[%] | 100% | | | 100% | | |
| Dec Time[%] | 99% | | | 98% | | |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Random Access HE | | | Random Access LC | | |
| Y | U | V | Y | U | V |
| Class A | 0.1% | 0.0% | -0.1% | 0.2% | 0.1% | 0.0% |
| Class B | 0.0% | 0.0% | 0.0% | 0.1% | 0.0% | 0.0% |
| Class C | 0.0% | 0.0% | 0.1% | 0.0% | 0.0% | 0.1% |
| Class D | 0.0% | -0.2% | -0.1% | 0.0% | 0.0% | -0.1% |
| Class E |  |  |  |  |  |  |
| **Overall** | 0.0% | -0.1% | 0.0% | 0.1% | 0.0% | 0.0% |
|  | 0.0% | -0.1% | 0.0% | 0.1% | 0.0% | 0.0% |
| Class F | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Enc Time[%] | 100% | | | 100% | | |
| Dec Time[%] | 98% | | | 100% | | |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Low delay B HE | | | Low delay B LC | | |
| Y | U | V | Y | U | V |
| Class A |  |  |  |  |  |  |
| Class B | 0.1% | -0.1% | 0.0% | 0.1% | -0.1% | -0.1% |
| Class C | 0.1% | -0.1% | 0.1% | 0.1% | 0.1% | -0.1% |
| Class D | 0.0% | 0.1% | 0.6% | 0.0% | 0.3% | 0.3% |
| Class E | 0.6% | 0.2% | 0.0% | 0.3% | 0.0% | 0.1% |
| **Overall** | 0.2% | 0.0% | 0.2% | 0.1% | 0.1% | 0.0% |
|  | 0.2% | 0.0% | 0.1% | 0.1% | 0.0% | 0.1% |
| Class F | -0.1% | -0.2% | -0.3% | 0.0% | -0.2% | -0.3% |
| Enc Time[%] | 100% | | | 100% | | |
| Dec Time[%] | 99% | | | 97% | | |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Low delay P HE | | | Low delay P LC | | |
| Y | U | V | Y | U | V |
| Class A |  |  |  |  |  |  |
| Class B | 0.1% | 0.2% | 0.1% | 0.0% | 0.1% | -0.3% |
| Class C | 0.1% | -0.1% | -0.1% | 0.0% | 0.1% | 0.1% |
| Class D | 0.0% | 0.3% | -0.1% | -0.1% | -0.1% | 0.7% |
| Class E | 0.4% | -0.4% | 0.2% | 0.4% | -0.6% | -0.8% |
| **Overall** | 0.1% | 0.1% | 0.1% | 0.1% | -0.3% | 0.0% |
|  | 0.1% | 0.1% | 0.0% | 0.1% | -0.2% | 0.0% |
| Class F | -0.1% | 0.2% | 0.3% | 0.1% | -1.0% | 0.1% |
| Enc Time[%] | 100% | | | 100% | | |
| Dec Time[%] | 99% | | | 100% | | |

# Conclusion

This contribution proposes simplification of first delta calculation used for deblocking. Furthermore, for unification of the luma and chroma filters, the same first delta calculation is used for the luma weak filter and chroma filter. Simulation results show that the BD-rate results and subjective quality are similar to the HM5.0 anchor.

# Working draft text modifications

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| – Otherwise, the following weak filtering applies while nDp and nDq are set equal to 0:  ~~Δ = ( 9 \* ( q~~~~0~~~~–  p~~~~0~~~~) – 3 \* ( q~~~~1~~~~– p~~~~1~~~~) + 8 ) >> 4 (8‑456)~~  Δ = ( 4 \* ( q0 –  p0 ) – ( q1 – p1 ) + 4 ) >> 3 (8‑456)   * + When abs(Δ) is less than tc\*10, the following ordered steps apply:     - The filtered sample values p0’ and q0’ are specified as follows:   Δ = Clip3( -tc, tc, Δ ) (8‑456)  p0’ = Clip1Y( p0 + Δ ) (8‑457)  q0’ = Clip1Y( q0 - Δ ) (8‑458)   * + - If dEp1 is equal to 1, the filtered sample value pi’ is specified as follows:   Δp = Clip3( -(tc >> 1), tc >> 1, ( ( ( p2 + p0 + 1 ) >> 1 ) – p1 + Δ ) >>1 ) (8‑458)  pi’ = Clip1Y( p1 + Δp ) (8‑458)   * + - If dEq1 is equal to 1, the filtered sample value qi’ is specified as follows:   Δq = Clip3( -(tc >> 1), tc >> 1, ( ( ( q2 + q0 + 1 ) >> 1 ) – q1 – Δ ) >>1 ) (8‑458)  qi’ = Clip1Y( q1 + Δq ) (8‑458)   * + - nDp is set equal to dEp1+1 and nDq is set equal to dEq1+1. |

# References

[1] J. Yang, K. Won, B. Jeon, and J. Lim, “CE12: SK Telecom/SKKU Deblocking Filter,” JCTVC-F258, Torino, IT, July 2011.

[2] Benjamin Bross, Woo-Jin Han, Jens-Rainer Ohm, Gary J. Sullivan, and Thomas Wiegand, “WD5: Working Draft 5 of High-Efficiency Video Coding,” JCTVC-G1103, Geneva, CH, Nov. 2011.

[3] F. Bossen, “Common test conditions and software reference configurations,” JCTVC-G1200, Geneva, CH, Nov. 2011.

# Patent right declaration(s)

**SK Telecom and Sungkyunkwan University 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).**