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| **Joint Collaborative Team on Video Coding (JCT-VC)**  **of ITU-T SG16 WP3 and ISO/IEC JTC1/SC29/WG11**  8th Meeting: San Jose, CA, USA, 1-10 February, 2012 | Document: JCTVC-H0084  M22956 |

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| *Title:* | **CE10 Subtest 1: Test results on unification of luma and chroma filtering** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Proposal | | |
| *Author(s) or Contact(s):* | Minhua Zhou Texas Instruments Inc., USA | Tel: Email: | +1-214-480-3816 [zhou@ti.com](mailto:zhou@ti.com) |
| *Source:* | Texas Instruments Inc; | | |

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# Abstract

This contribution reports test results on CE10 subset 1 “unification of luma and chroma filtering”. In the proposed algorithm the unification of luma and chroma filtering is achieved by using the same logic for delta value calculation of luma weak and chroma filter. Since de-blocking filter does not have throughput issue, such a unification enables logic sharing between luma and chroma filtering. The change also leads to slight improvement in coding efficiency. Simulation results revealed that the proposed unification improved the coding efficiency in luma by 0.2% in AI-LC, and 0.1% in AI-HE, RA-HE, RA-LC, LB-HE and LB-LC, and up to 0.1% to 0.3% gain for chroma components.

# Introduction

This contribution reports test results on CE10 subset 1 “unification of luma and chroma filtering”.

# Algorithm description

It is proposed to unify the luma weak and chroma filter, this will not only simplify the de-blocking filter design but also improves coding efficiency.

*Chroma filter HM-5.0 : delta = Clip3(-tc,tc, ((((m4 - m3)<<2) + m2 - m5 + 4 )>>3) );*

*Chroma filter proposed : delta = Clip3(-tc,tc,((13\*(m4-m3) - 4\*(m5-m2) + 16)>>5) );*

*Luma Weak filter HM5.0: delta = (9\*(m4-m3) -3\*(m5-m2) + 8)>>4*

*Luma Weak filter proposed (HM3.0) : delta = (13\*(m4-m3) - 4\*(m5-m2) + 16) >> 5;*

This change has no impact on software as total number of operations remains same. In Hardware this will reduce the implementation complexity by sharing same logic for Luma-weak filter and Chroma filter.

# Test Settings and Conditions

The simulations of this document have used HM5.0 software, the simulation platform is LSF equipped with Intel(R) Xeon(R) CPU X5570@2.93GHz 64 bits Linux machines, the common test conditions and reference configurations specified in [1] are followed.

# Experimental results

The experimental results are summarized in Table 1. The proposed unification improves the coding efficiency in luma by 0.2% AI-LC, and 0.1% in AI-HE, RA-HE, RA-LC, LB-HE and LB-LC. The minor coding efficiency improvements (0.1% -0.3%) have also been observed in chroma components.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **All Intra HE** | | | **All Intra LC** | | |
|  | Y | U | V | Y | U | V |
| Class A (8bit) | -0.2% | -0.2% | -0.1% | -0.2% | -0.2% | -0.1% |
| Class B | -0.2% | -0.2% | -0.2% | -0.3% | -0.4% | -0.3% |
| Class C | -0.1% | -0.2% | -0.2% | -0.2% | -0.3% | -0.3% |
| Class D | -0.1% | -0.1% | -0.1% | -0.1% | -0.2% | -0.2% |
| Class E | -0.1% | 0.0% | 0.0% | -0.2% | 0.2% | 0.0% |
| **Overall** | -0.1% | -0.1% | -0.1% | -0.2% | -0.2% | -0.2% |
|  | -0.1% | -0.1% | -0.1% | -0.2% | -0.2% | -0.2% |
| Class F | 0.0% | -0.1% | -0.1% | -0.1% | -0.1% | -0.1% |
| Enc Time[%] | 96% | | | 99% | | |
| Dec Time[%] | 96% | | | 98% | | |
|  | **Random Access HE** | | | **Random Access LC** | | |
|  | Y | U | V | Y | U | V |
| Class A (8bit) | -0.1% | -0.1% | -0.2% | -0.1% | -0.1% | 0.0% |
| Class B | -0.1% | -0.2% | -0.1% | -0.1% | -0.1% | -0.2% |
| Class C | -0.1% | -0.2% | -0.1% | 0.0% | -0.2% | -0.1% |
| Class D | -0.1% | -0.3% | -0.2% | -0.1% | -0.2% | -0.2% |
| Class E |  |  |  |  |  |  |
| **Overall** | -0.1% | -0.2% | -0.1% | -0.1% | -0.1% | -0.1% |
|  | -0.1% | -0.2% | -0.1% | -0.1% | -0.1% | -0.2% |
| Class F | -0.1% | -0.2% | -0.2% | -0.1% | -0.1% | -0.1% |
| Enc Time[%] | 100% | | | 101% | | |
| Dec Time[%] | 101% | | | 101% | | |
|  | **Low delay B HE** | | | **Low delay B LC** | | |
|  | Y | U | V | Y | U | V |
| Class A |  |  |  |  |  |  |
| Class B | -0.2% | 0.0% | -0.1% | -0.2% | -0.3% | 0.2% |
| Class C | -0.1% | -0.3% | 0.0% | -0.1% | -0.2% | -0.2% |
| Class D | -0.1% | -0.2% | 0.0% | -0.1% | 0.6% | -0.1% |
| Class E | -0.2% | 0.8% | 0.1% | -0.1% | -0.3% | -0.1% |
| **Overall** | -0.1% | 0.0% | 0.0% | -0.1% | -0.1% | 0.0% |
|  | -0.1% | 0.0% | -0.1% | -0.1% | 0.0% | 0.0% |
| Class F | -0.1% | -0.4% | -0.4% | -0.1% | -1.2% | -0.2% |
| Enc Time[%] | 98% | | | 99% | | |
| Dec Time[%] | 96% | | | 97% | | |

**Table 1. Experimental results (unified luma weak and chroma filter).**

# Conclusion and recommendation

It is recommended to adopt this simplification method for quality improvement and complexity reduction purpose if no visual quality difference compared to the current HM5.0 design is found.

# References

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

[2] [B. Bross](mailto:benjamin.bross@hhi.fraunhofer.de), [W.-J. Han](mailto:wjhan.han@samsung.com), [J.-R. Ohm](mailto:ohm@ient.rwth-aachen.de), [G. J. Sullivan](mailto:garysull@microsoft.com), [T. Wiegand](mailto:thomas.wiegand@hhi.fraunhofer.de) “High Efficiency Video Coding (HEVC) text specification Working Draft 5” JCT-VC Document, JCTVC-F1103, Geneva, CH, Nov. 2011

[3] M. Sadafale, “Improving Deblocking filter efficiency”, JCTVC document JCTVC-F256, Torino, IT, 14-22 July, 2011

[4] M.Zhou, O.Sezer, V. Sze, “CE12 subset 4.10: Test results on unification of luma and chroma filtering”, JCT-VC Document, JCTVC-G087, Geneva, CH, Nov. 2011.

[5] A. Norkin, X. Guo, B. Jeon and M. Narroschke, “**Description of Core Experiment 10: Deblocking Filtering** “,JCTVC document JCTVC-F1210, Geneva, CH, Nov. 2011

# Patent rights declaration(s)

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# Required Changes in Working Draft

In 8.6.1.4.5 Filtering process for a luma sample

Replace

Δ = ( 9 \* ( q0 –  p0 ) – 3 \* ( q1 – p1 ) + 8 ) >> 4 (8‑456)

With

Δ = ( 13 \* ( q0 –  p0 ) – 4 \* ( q1 – p1 ) + 16 ) >> 5 (8‑456)

In 8.6.1.4.6 Filtering process for a chroma sample

Replace

Δ = Clip3( -tC, tC, ( ( ( ( q0 – p0 ) << 2 ) + p1 – q1 + 4 ) >> 3 ) ) (8‑461)

With

Δ = Clip3( -tC, tC,  13 \* ( q0 –  p0 ) – 4 \* ( q1 – p1 ) + 16 ) >> 5) (8‑461)