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| *Title:* | **Non-CE9: On chroma boundary filtering** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Proposal | | |
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# Abstract

This proposal presents a chroma boundary filter design based on DM mode for 4:4:4 chroma format. The simulation results report that the proposed method achieves 1.5% and 1.3% BD-rate savings for mixed content RGB 1440p and 1080P respectively against the SCM2.0 anchor in the full frame intra BC test condition.

# Introduction

# When the intra prediction mode is DC, horizontal or vertical, for prediction in the left column and/or top row of the block is modified using the reference samples from the neighboring blocks. This is referred to as boundary filtering. Boundary filtering is applied only to the first component (Y) but not to the remaining components (Cb and Cr) in SCM2.0. If the format is GBR 4:4:4, boundary filtering is applied only to G but not to B and R components.

# Problems with the current boundary filter design

Another coding tool that may be applied to the 4:4:4 chroma format is known as cross component prediction (CCP). The basic idea is that the Cb/B and Cr/R residuals are predicted from the Y/G residuals. For intra-coded blocks, CCP can be used only when the chroma prediction mode is DM, meaning that the chroma intra prediction mode is same as luma.

Interaction of CCP and boundary filtering may be problematic. For example, if the luma prediction mode is DC, horizontal and vertical and CCP is used for that block, luma residual is based on prediction that is generated using boundary filtering. When this residual is used to predict chroma residual which is based on prediction that is generated without boundary filtering, the prediction may lose its effectiveness.

One solution that is proposed in JCTVC-S0082 [1] is to extend boundary filtering to the 2nd and 3rd components. The boundary filtering is applied to intra-coded blocks in 2nd and 3rd components when the prediction mode is DC, horizontal or vertical. This includes cases when the chroma prediction mode is DM and the luma prediction mode is DC, horizontal or vertical. But this increases the amount of boundary filtering substantially and the benefits are not clear-cut. For example, turning off boundary filtering for all the components as proposed in JCTVC-S0102 [2] also shows BD-rate improvement.

# Proposed chroma boundary filter based on DM mode

Since not using boundary filtering for the 2nd and 3rd components is problematic when CCP is ON, we propose the following way of boundary filtering for chroma components (2nd and 3rd component).

Boundary filtering is applied to chroma components (2nd and 3rd components) if all of the conditions below are satisfied:

• The block is intra-coded

• The chroma intra prediction mode is DM and the corresponding luma prediction mode is DC, horizontal or vertical.

# Simulation results

The proposed scheme is implemented on SCC common software and tested using the common test condition defined in [3]. Table 1 demonstrates the coding performance with the proposed chroma boundary filter.

Table 1: Proposed chroma boundary filter based on DM mode

|  |  |  |  |
| --- | --- | --- | --- |
|  | **All Intra** | | |
|  | G/Y | B/U | R/V |
| RGB, text & graphics with motion, 1080p | -0.2% | -0.1% | -0.1% |
| RGB, text & graphics with motion,720p | -0.8% | -0.4% | -0.5% |
| RGB, mixed content, 1440p | -1.5% | -0.9% | -1.0% |
| RGB, mixed content, 1080p | -1.3% | -0.9% | -0.8% |
| RGB, Animation, 720p | -0.5% | -0.3% | -0.4% |
| RGB, camera captured, 1080p | -0.4% | -0.4% | -0.4% |
| YUV, text & graphics with motion, 1080p | -0.1% | 0.0% | 0.0% |
| YUV, text & graphics with motion,720p | -0.1% | -0.1% | 0.0% |
| YUV, mixed content, 1440p | -0.1% | -0.1% | 0.0% |
| YUV, mixed content, 1080p | -0.2% | -0.1% | 0.0% |
| YUV, Animation, 720p | -0.1% | -0.1% | 0.1% |
| YUV, camera captured, 1080p | -0.1% | 0.0% | -0.2% |
| Enc Time[%] | 96% | | |
| Dec Time[%] | 93% | | |

# Conclusions

This proposal presents a chroma boundary filter based on DM mode for 4:4:4 chroma format. And the proposed method reduces the number of cases for chroma boundary filtering. The simulation results report that the proposed method achieves 1.5% and 1.3% BD-rate savings for mixed content RGB 1440p and 1080P respectively against the SCM2.0 anchor in the full frame intra BC test condition.

# Patent rights declaration(s)

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# References

1. B. Li, J. Xu, X. Zhang, R. Cohen, “CE9: Result of Test A.2”, JCTVC-S0082
2. X. Zhang, K. Zhang, J. An, H. Huang, S. Lei, “CE9 Test A.1: Optionally disabling the usage of the intra boundary filters”, JCTVC-S0102
3. H. Yu, R. Cohen, K. Rapaka, and J. Xu, “Common conditions for screen content coding tests,” JCTVC-R1015, Sapporo, Japan, June 2014.