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| **Joint Collaborative Team on Video Coding (JCT-VC)**  **of ITU-T SG 16 WP 3 and ISO/IEC JTC 1/SC 29/WG 11**  13th Meeting: Incheon, KR, 18–26 Apr. 2013 | Document: JCTVC-M0253 |

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| *Title:* | **Non-SCE4: Simplification of chroma enhancement for inter layer reference picture generation** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Proposal | | |
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# Abstract

A method to utilize luma component to enhance chroma components when generating inter-layer reference pictures was proposed in the 12th JCT-VC meeting. Due to the 3×4 filter used by the method, additional 13 multiplications and 12 additions were introduced for each chroma sample. To reduce the computational complexity while keeping the coding performance, it is proposed to simplify the method by replacing the 3×4 filter with an 8-point cross-shaped filter. It is reported that a similar performance to the original method can be obtained while the number of additional multiplication and additions are reduced by around 30% in the worst case.

# Introduction

In [1][2], a method was proposed to enhance chroma components with information from luma component when generating inter-layer reference (ILR) pictures.

Figure 1 shows the relative luma and chroma sample positions in 4:2:0 color format. Each chroma sample (red dot) in an ILR picture is enhanced by adding an appropriate offset, where the offset is the result of filtering the surrounding 3×4 luma samples (white squares) by a high-pass filter. The coefficients of the high-pass filter are signaled for each chroma component in an enhancement layer picture.

At decoder, enhanced chroma samples are generally calculated as follows

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where , and represent chroma and luma samples at location in the ILR picture (up-sampled when necessary), and indicate the two 3×4 high-pass filters, and denote the enhanced chroma samples. Please note that (1) shows the general idea of [1][2]. Additional operations like scaling are needed for the second term of (1) to finally derive enhanced chroma samples.

With the method, 13 multiplications (additional one for scaling) and 12 additions are needed for each chroma sample, which costs much in practice.



Figure . Relative Luma and Chroma sample positions in 4:2:0 color subsampling format [1][2]

# Proposed simplification

To reduce computational complexity, it is proposed to replace the 3×4 high-pass filter with an 8-point cross-shaped high-pass filter, as shown in Figure 2.



Figure 2. Proposed 8-point cross-shaped high-pass filter

The proposed 8-point filter only needs 9 multiplications and 8 additions for each chroma sample. Consequently, compared to the 12-point 3×4 filter, around 30% of computational complexity was saved.

# Simulation results

The method is experimentally verified under the SHVC common test conditions defined in [3]. As shown in Table 1, compared to SHM-1.0 RefIdx anchor, 0.8%, 7.1%, and 9.0% BD-rate reduction was obtained for Y, Cb, and Cr components in all intra cases, and 0.3%, 7.2%, and 8.2% BD-rate reduction for inter cases (RA, LD-P, and LD-B) on average.

Table 2 shows that compared to the 3×4 chroma enhancement filter [2], the performance loss is 0.0%, 0.4%, and 0.1% for Y, Cb, and Cr components, respectively.

Please note that the timing information is not reliable.

Table . Compared to SHM-1.0 RefIdx anchor



Table . Compared to the 3×4 Chroma enhancement filter [2]



# Conclusions

In this proposal, a method to simplify the 3×4 chroma enhancement filter for generating inter-layer reference picture is proposed. Simulations show that the number of multiplication and addition is reduced by around 30% in the worst case while a quite close coding performance to the original method is kept.

# Patent rights declaration(s)

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**Reference**

1. J. Dong, Y. He, Y. Ye, “Chroma enhancement for ILR picture,” JCTVC-L0059, Geneva, Switzerland, Jan. 2013.
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3. X. Li, J. Boyce, P. Onno, Y. Ye, “Common SHM test conditions and software reference configurations,” JCTVC-L1009, Geneva, Switzerland, Jan. 2013.