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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**  16th Meeting: San José, US, 9–17 Jan. 2014 | Document: JCTVC-P0129 |

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| *Title:* | Non-SCE1: Cross-check report of Asymmetric 3D LUT for Color Gamut Scalability (JCTVC-P0063) | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Proposal | | |
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| *Source:* | Technicolor | | |

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# Abstract

This contribution reports the crosschecking results for JCTVC-P0063 on Asymmetric 3D LUT for color gamut and bit-depth scalability. The simulation results reportedly matched those provided by the proponents.

# Introduction

JCTVC-P0063 proposes to use 8x2x2 LUTs (asymmetric), where each partition or cuboid has 4 parameters (a,b,c,d). This representation is equivalent to have 4 vertices per cuboid, each one composed of 3 components values (Y,U,V), as depicted in Figure 1. Then, the interpolation process is same as the traditional tetrahedral LUT interpolation, but using always the same set of 4 vertices.



Figure : Each cuboid has 4 vertices associated with.

The vertices color components values are derived for each cuboid by minimizing the distortion between converted samples and original enhancement signal.

The color mapping is made after up-sampling: this is probably the reason why the decoding time is increased compared to anchors.

The lookup table is signaled in the slice header.

# Experimental results

We received the source code from the proponents, implemented on top of SHM-4.0 SCE1 anchor software (*SHM4.0\_irap\_2013\_11\_28*), and did a code study to verify that the proposed method was implemented as described. We ran simulations for the cases of AI-2x, RA-2x with SCE1 test sequences [1].

The results matched what were provided by the proponents and are summarized as follows.

Two use cases has been considered. For all the considered use cases, the LUTs are derived and up-dated for each frames.

* Use case A: one single SPS, PPS is inserted at the beginning of the sequence.
* Use case B: one SPS, PPS is inserted every second.

## Use case A

Table 3: Results of use case A.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **AI HEVC 2x 10-bit base** | | | **AI HEVC 2x 8-bit base** | | |
|  | Y | U | V | Y | U | V |
| Class A+ |  |  |  |  |  |  |
| **Overall (Test vs Ref)** | -8.2% | -11.4% | -15.0% | -8.2% | -11.4% | -14.9% |
| **Overall (Test vs single layer)** | 8.7% | 8.6% | 0.6% | 11.2% | 10.3% | 2.0% |
| **Overall (Ref vs single layer)** | 18.5% | 22.8% | 18.1% | 21.2% | 24.7% | 19.4% |
| **EL only (Test vs Ref)** | -16.2% | -18.9% | -22.5% | -16.1% | -18.9% | -22.4% |
| **Overall (Test EL+BL vs single EL+BL)** | -28.8% | -28.2% | -34.9% | -27.2% | -27.1% | -34.2% |
| **Overall (Ref EL+BL vs single EL+BL)** | -22.4% | -19.5% | -22.8% | -20.7% | -18.4% | -22.0% |
| Enc Time[%] | 109.7% | | | 108.8% | | |
| Dec Time[%] | 114.7% | | | 115.6% | | |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **RA HEVC 2x 10-bit base** | | | **RA HEVC 2x 8-bit base** | | |
|  | Y | U | V | Y | U | V |
| Class A+ |  |  |  |  |  |  |
| **Overall (Test vs Ref)** | -6.3% | -10.3% | -13.9% | -6.2% | -10.3% | -13.5% |
| **Overall (Test vs single layer)** | 19.3% | 20.1% | 9.0% | 21.1% | 21.6% | 10.6% |
| **Overall (Ref vs single layer)** | 27.5% | 33.7% | 26.9% | 29.2% | 35.2% | 27.8% |
| **EL only (Test vs Ref)** | -11.7% | -15.3% | -18.9% | -11.5% | -15.2% | -18.4% |
| **Overall (Test EL+BL vs single EL+BL)** | -20.5% | -17.7% | -27.1% | -19.5% | -17.0% | -26.3% |
| **Overall (Ref EL+BL vs single EL+BL)** | -15.2% | -9.9% | -14.3% | -14.3% | -9.3% | -14.0% |
| Enc Time[%] | 70.9% | | | 70.6% | | |
| Dec Time[%] | 129.0% | | | 126.5% | | |

## Use case B

Table 5: Results of use case B.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **AI HEVC 2x 10-bit base** | | | **AI HEVC 2x 8-bit base** | | |
|  | Y | U | V | Y | U | V |
| Class A+ |  |  |  |  |  |  |
| **Overall (Test vs Ref)** | -8.4% | -11.5% | -15.2% | -8.4% | -11.5% | -15.1% |
| **Overall (Test vs single layer)** | 8.5% | 8.5% | 0.4% | 11.0% | 10.2% | 1.7% |
| **Overall (Ref vs single layer)** | 18.5% | 22.8% | 18.1% | 21.2% | 24.7% | 19.4% |
| **EL only (Test vs Ref)** | -16.6% | -19.2% | -23.0% | -16.6% | -19.3% | -22.9% |
| **Overall (Test EL+BL vs single EL+BL)** | -29.0% | -28.3% | -35.1% | -27.3% | -27.2% | -34.3% |
| **Overall (Ref EL+BL vs single EL+BL)** | -22.4% | -19.5% | -22.8% | -20.7% | -18.4% | -22.0% |
| Enc Time[%] | 108.3% | | | 108.3% | | |
| Dec Time[%] | 109.4% | | | 114.4% | | |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **RA HEVC 2x 10-bit base** | | | **RA HEVC 2x 8-bit base** | | |
|  | Y | U | V | Y | U | V |
| Class A+ |  |  |  |  |  |  |
| **Overall (Test vs Ref)** | -6.6% | -9.8% | -14.2% | -6.4% | -9.8% | -13.9% |
| **Overall (Test vs single layer)** | 19.0% | 20.8% | 8.7% | 20.9% | 22.3% | 10.1% |
| **Overall (Ref vs single layer)** | 27.5% | 33.7% | 26.9% | 29.2% | 35.2% | 27.9% |
| **EL only (Test vs Ref)** | -12.1% | -14.9% | -19.3% | -11.9% | -14.9% | -18.9% |
| **Overall (Test EL+BL vs single EL+BL)** | -20.8% | -17.3% | -27.4% | -19.7% | -16.6% | -26.7% |
| **Overall (Ref EL+BL vs single EL+BL)** | -15.2% | -9.9% | -14.3% | -14.3% | -9.3% | -14.0% |
| Enc Time[%] | 73.1% | | | 72.7% | | |
| Dec Time[%] | 123.1% | | | 126.3% | | |

# Conclusion

In this contribution, we have presented the results of our cross-check of JCTVC-P0063. The implemented algorithm is in line with the proponent’s description, and the simulation results also match those provided by the proponents.

# References

1. P. Bordes, Y. Ye, E. Alshina, X. Li, S.-H. Kim, A. Duenas, K. Ugur, K. Sato, “Description of HEVC Scalable Extensions Core Experiment SCE1: Color Gamut and Bit-Depth Scalability”, JCTVC-O1101, Oct. 2013, CH