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| *Title:* | **A Crosscheck of JCTVC-Y0033: On HDR 4:2:0 chroma subsampling (AHG13 related)** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Crosscheck | | |
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| *Source:* | Dolby Laboratories, Inc. | | |

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# Abstract

This document reports a crosscheck results for proposal JCTVC-Y0033 on closed form HDR 4:2:0 chroma subsampling. Y0033 evaluated several luma adjustment algorithms (disable, iterative micro-grading, proposed Algorithm1 and proposed Algorithm2) with LUT speed-up. We repeated the experiments and the objective metrics matched with those results provided in JCTVC-Y0033. It is observed from the results that Algorithm 2 minimizing the linear luminance closely resembles in performance the luma micro-grading algorithm while the complexity in terms of conversion time is significantly reduced.

# Introduction

Luma adjustment was initially introduced to correct the non-constant luminance error of NCL YCbCr introduced in chroma downsampling in the pre-processing stage before encoding. The original iterative micro-grading algorithm used in current Anchor generation process is having very high complexity due to the iterative close loop conversion. JCTVC-X0072 [1] proposed two closed-form solutions to reduce the complexity and tested its effect under various conditions. In JCTVC-Y0033 [2], complexity of the proposed two algorithms is further reduced by LUT speed-up.

The experiments are conducted using v0.12 of HDRTools software [3] and are purely conversion-only tests consisting end to end RGB to YCbCr420 to RGB conversion. Several luma adjustment algorithms are evaluated by setting different values of parameter “ClosedLoopConversion” in HDRTools configuration file:

* Direct: disable luma adjust (ClosedLoopConversion = 0)
* Micro-grading: iterative luma adjust with 10 iterations (ClosedLoopConversion = 5)
* Algorithm1: (ClosedLoopConversion = 16)
* Algorithm2: (ClosedLoopConversion = 17)

The downsampling filter and upsampling filter used in pre-processing are kept same as in Anchor generation process. The parameters “EnableTFunctionLUT” and “EnableTFDerivLUT” are set to 1 to enable LUT speed-up.

# Simulation results

Table 1 and Table 2 show the PSNR results for conversion only in different test cases. These results match those provided in JCTVC-Y0033 (Table 1-2). We also observed the complexity difference between the tested algorithms. All the conversions are conducted on the same testing platform (Xeon-E5-2643v2@3.5GHz, RAM=128GB CentOS system). It can be observed from the results that Algorithm 2 minimizing the linear luminance closely resembles in performance the luma micro-grading algorithm while the complexity in terms of conversion time is significantly reduced. Per-sequence results can be found in the attached excel sheet.

Table 1. BT.709 container (averages). Total conversion time over all sequences in the set is reported.

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|  | tPSNR-X | tPSNR-Y | tPSNR-Z | tPSNR-XYZ | tOSNR-XYZ | DE100 | MD100 | PSNRL100 | Conv. Time (sec) | time over direct |
| direct | 51.01 | 55.11 | 48.02 | 50.35 | 50.70 | 39.47 | 22.40 | 45.62 | 959.19 | 100% |
| micro-grading | 56.57 | 69.77 | 47.68 | 51.87 | 51.75 | 39.96 | 22.46 | 49.63 | 5540.81 | 578% |
| algo.1 | 59.26 | 54.05 | 46.84 | 50.59 | 51.08 | 40.09 | 22.26 | 44.30 | 2074.67 | 216% |
| algo.2 | 56.54 | 66.67 | 47.65 | 51.82 | 51.74 | 39.95 | 22.40 | 49.27 | 2077.50 | 217% |

Table . BT.2020 container (averages). Total conversion time over all sequences in the set is reported.

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|  | tPSNR-X | tPSNR-Y | tPSNR-Z | tPSNR-XYZ | tOSNR-XYZ | DE100 | MD100 | PSNRL100 | Conv. Time (sec) | time over direct |
| direct | 52.40 | 62.69 | 44.43 | 48.42 | 47.34 | 37.96 | 22.78 | 48.72 | 1589.32 | 100% |
| micro-grading | 54.06 | 69.71 | 44.16 | 48.45 | 47.45 | 38.05 | 22.79 | 50.68 | 8733.47 | 550% |
| algo.1 | 55.92 | 53.75 | 45.14 | 48.88 | 48.19 | 38.10 | 22.75 | 44.89 | 3509.40 | 221% |
| algo.2 | 54.11 | 68.22 | 44.16 | 48.45 | 47.45 | 38.05 | 22.77 | 50.43 | 3505.93 | 221% |

# References

1. Andrey Norkin, “On closed form HDR 4:2:0 chroma subsampling (AHG13 related)”, JCTVC-X0072, May. 2016, Geneva, CH.
2. Andrey Norkin, “On HDR 4:2:0 chroma subsampling (AHG13 related)”, JCTVC-Y0033, Oct. 2016, Chengdu, CN.
3. HDRTools software package (Apple). Alexis M. Tourapis.