



CREATING THE LIVING NETWORK™

JVET-L0238

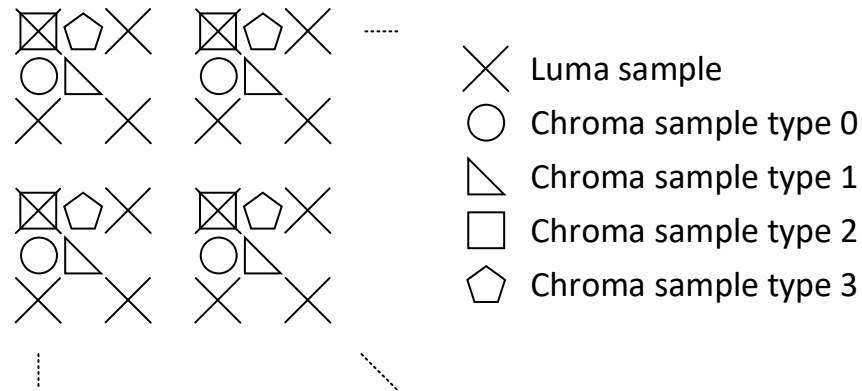
AHG8: Chroma sample location type support
for 360Lib

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Introduction

- In 4:2:0 chroma format, the chroma sample location type defines the position of chroma samples with respect to luma samples



- 360Lib uses type-2 when the internal chroma format is set to 4:2:0
 - For projection format conversion, chroma sampling grid is first scaled up by a factor of 2 to align with the luma sampling grid before conversion, and is scaled down by a factor of 2 after conversion

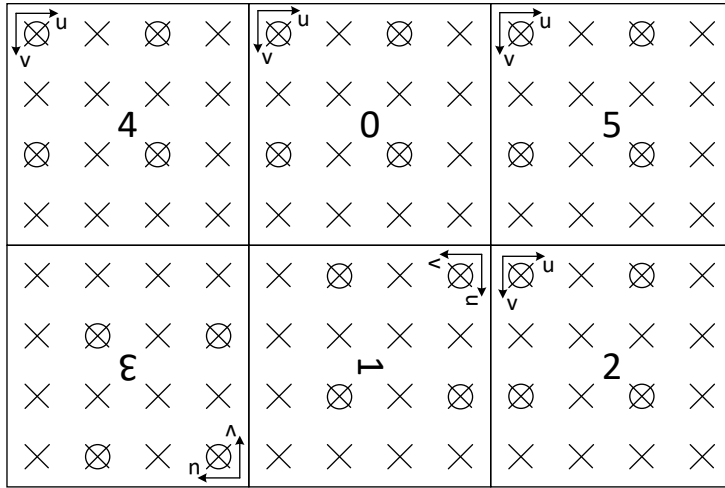
Problem Statement (1/3)

Several issues have been identified in 360Lib and 360° CTC related to the chroma sample location type

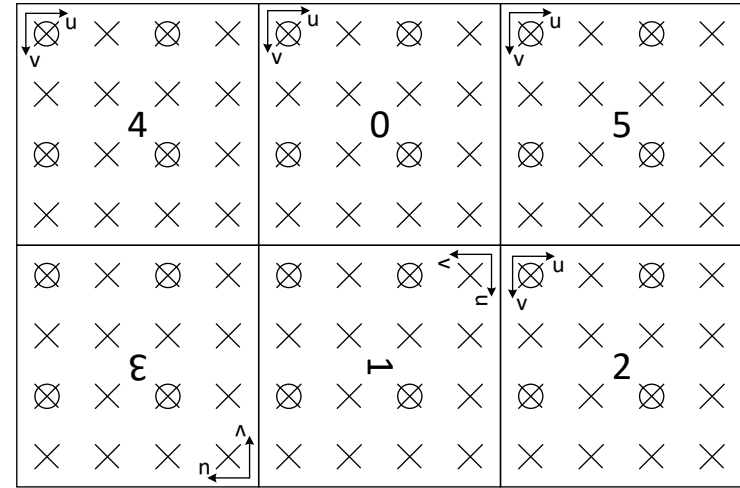
1. Type-2 is assumed for the input and output, whereas the 360° video sequences in CTC are in type-0
2. The input and output chroma types cannot be specified independently
3. Only types 0 and 2 are supported, but not always correctly
4. Input/output using type-0 is only supported by means of resampling between type-0 and type-2
5. Only WS-PSNR supports different chroma types, other metrics only support type-2

Problem Statement (2/3)

6. When a multi-face project format is used, e.g., CMP, different rotations are applied to different faces, causing the chroma type to be inconsistent among different faces within a frame packed picture



360Lib output for type-2

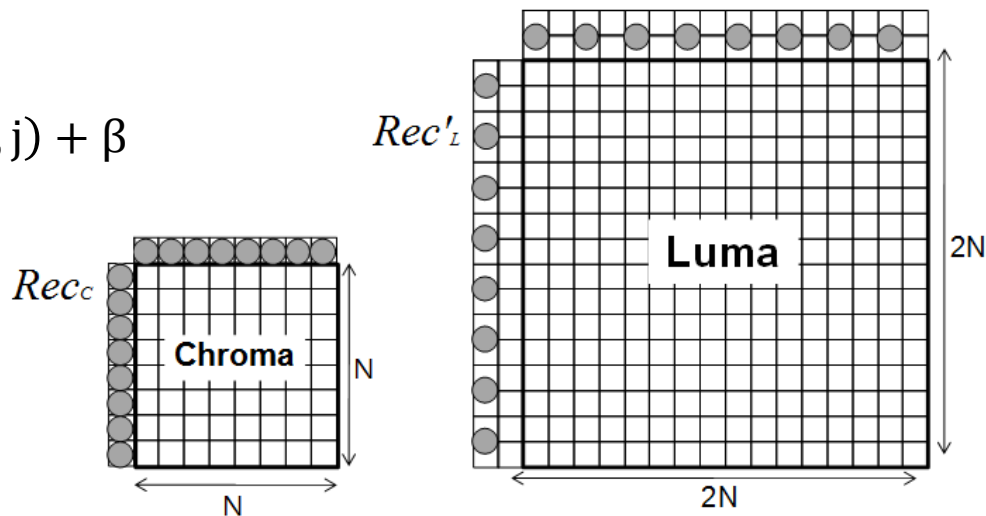


Expected output for type-2

Problem Statement (3/3)

7. The cross-component linear model (CCLM) tool in VTM-2.0 assumes type-0 when downsampling the reconstructed chroma samples
- If the input video has a chroma type different from the one assumed in CCLM mode, an average coding loss in the range of 1% to 2% is observed on the chroma components*

$$\text{pred}_C(i, j) = \alpha \cdot \text{rec}_L'(i, j) + \beta$$



*P. Hanhart, Y. He, Y. Ye, "CE3-related: Enabling different chroma sample location types in CCLM", JVET-L0239.

Proposed Fix

To resolve these problems, the following actions are proposed:

1. Change the default chroma type to type-0 in CTC
2. Add parameters to specify the chroma types of the input and output independently
3. Add support for all four chroma types
4. Modify mapping functions such that mathematically correct mapping and resampling is performed between all chroma types in a single step
5. Modify metric calculations such that mathematically correct calculation is performed considering the chroma types of the two inputs
6. Modify the mapping process of multi-face project formats to ensure that the chroma type of all faces are consistent within a frame packed picture

Simulation

	Anchor	Test
Conversion from original 8K/6K ERP to coded 4K PERP/HEC	360Lib-7.0	Modified 360Lib
Encoding	BMS-2.0.1 VTM configuration	BMS-2.0.1 VTM configuration
Conversion from decoded 4K PERP/HEC to reconstructed 8K/6K ERP	360Lib-7.0	Modified 360Lib
End-to-end metrics calculation	Modified 360Lib	Modified 360Lib

Simulation Results - PERP

	End-to-end WS-PSNR			End-to-end S-PSNR-NN		
	BD-rate(Y)	BD-rate(U)	BD-rate(V)	BD-rate(Y)	BD-rate(U)	BD-rate(V)
SkateboardInLot	-0.01%	-0.24%	-0.77%	-0.01%	-0.23%	-0.76%
ChairLift	0.00%	-1.53%	0.00%	0.00%	-1.51%	0.04%
KiteFlite	0.00%	-0.33%	-0.07%	-0.02%	-0.35%	-0.10%
Harbor	-0.01%	-0.38%	-0.88%	0.01%	-0.40%	-0.90%
Trolley	0.01%	-0.41%	-0.26%	0.00%	-0.39%	-0.22%
GasLamp	-0.03%	-0.32%	-0.43%	-0.06%	-0.28%	-0.47%
Balboa	0.03%	0.15%	-0.10%	0.04%	0.13%	-0.10%
Broadway	-0.02%	-0.03%	0.18%	-0.01%	-0.03%	0.18%
Landing2	0.04%	-0.14%	-0.04%	0.01%	-0.16%	-0.02%
BranCastle2	-0.02%	-0.30%	-0.19%	-0.02%	-0.31%	-0.19%
Average	0.00%	-0.35%	-0.26%	-0.01%	-0.35%	-0.26%

Simulation Results - HEC

	End-to-end WS-PSNR			End-to-end S-PSNR-NN		
	BD-rate(Y)	BD-rate(U)	BD-rate(V)	BD-rate(Y)	BD-rate(U)	BD-rate(V)
SkateboardInLot	0.03%	-0.93%	-0.54%	0.03%	-0.83%	-0.50%
ChairLift	-0.09%	-5.90%	-0.16%	-0.08%	-5.91%	-0.15%
KiteFlite	-0.02%	-0.86%	-1.60%	-0.06%	-0.82%	-1.60%
Harbor	-0.07%	-0.70%	-0.89%	-0.08%	-0.62%	-0.90%
Trolley	0.00%	-0.88%	-0.58%	-0.01%	-0.80%	-0.56%
GasLamp	-0.04%	-1.59%	-3.74%	-0.06%	-1.54%	-3.74%
Balboa	0.04%	-0.60%	-0.61%	0.07%	-0.57%	-0.58%
Broadway	-0.01%	-0.39%	-0.45%	-0.05%	-0.33%	-0.41%
Landing2	-0.02%	-0.47%	0.08%	-0.04%	-0.43%	0.12%
BranCastle2	-0.01%	-2.35%	-1.80%	0.00%	-2.35%	-1.81%
Average	-0.02%	-1.47%	-1.03%	-0.03%	-1.42%	-1.01%

Conclusion

- With the proposed fix, 360Lib can properly handle different chroma sample location types
- With the proposed modification to 360Lib, the average coding performance can be improved by
 - PERP: -0.35% and -0.26% for the U and V components
 - HEC: -1.47% and -1.03% for the U and V components
- Suggest to include this software fix in the next release of 360Lib and to update the configuration files for the 360° video CTC

Thanks to Samsung for cross-checking

THANK YOU!

