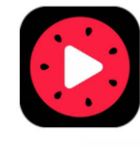


# JVET-P0383

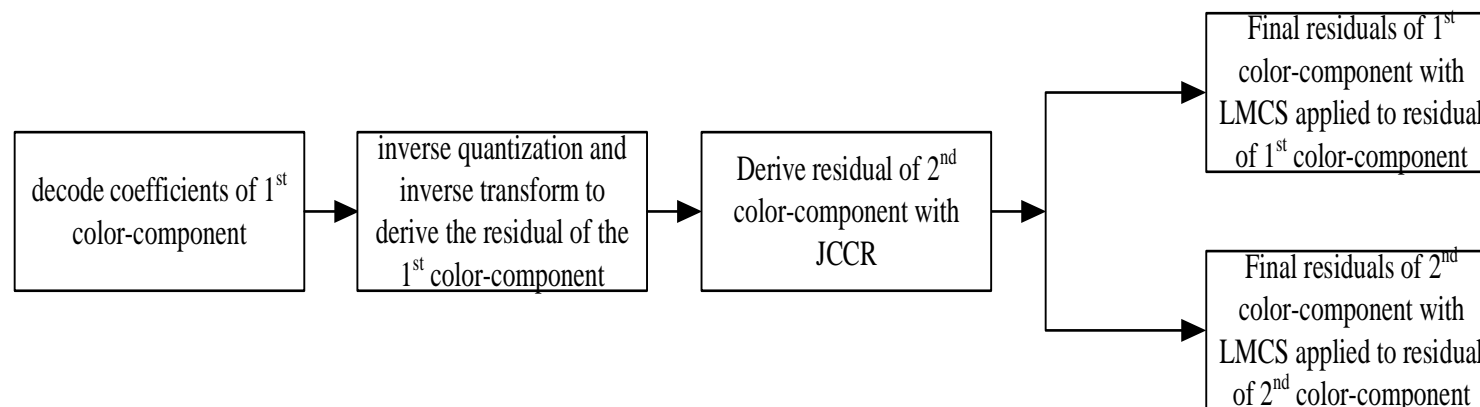
## NON-CE: JCCR AND LMCS INTERACTION

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# Background

- Luma Mapping with Chroma Scaling (LMCS) on chroma
  - *The per-sample scaling based on the corresponding luma reconstruction samples is applied to each of the residual blocks.*
- Joint Coding of Chroma Residual (JCCR)
  - *The residual blocks for chroma components are combined into one joint residual block and only the joint residual block needs to be coded.*
  - *At the decoder side, the joint chroma residual block is decoded and the residual blocks for chroma components are derived from it.*
- In VTM-6.0, LMCS is performed after JCCR



# Proposed

- Current design of JCCR and LMCS: LMCS is performed **after** JCCR
  - *The chroma scaling is operated **twice for JCCR mode**. An example for JCCR mode 2:*
    - $R_{Cr} = -R_{Cb}$
    - $R_{Cb} = \text{Clip3}( -(1 \ll \text{BitDepthC}), (1 \ll \text{BitDepthC}) - 1, R_{Cb} )$
    - $R_{Cr} = \text{Clip3}( -(1 \ll \text{BitDepthC}), (1 \ll \text{BitDepthC}) - 1, R_{Cr} )$
    - $R_{Cb} = \text{CS} * R_{Cb}$
    - $R_{Cr} = \text{CS} * R_{Cr}$
- Proposed method: LMCS is performed **before** JCCR
  - *The chroma scaling is performed **only once before JCCR**. An example for JCCR mode 2:*
    - $R_{Cb} = \text{Clip3}( -(1 \ll \text{BitDepthC}), (1 \ll \text{BitDepthC}) - 1, R_{Cb} )$
    - $R_{Cb} = \text{CS} * R_{Cb}$
    - $R_{Cr} = -R_{Cb}$

# Experimental results vs. VTM-6.0 (SDR)

## ■ CTC test

	All Intra Main10				
	Over VTM-6.0			EncT	DecT
	Y	U	V		
Class A1	0.00%	0.08%	0.06%	100%	98%
Class A2	0.02%	0.07%	0.01%	99%	99%
Class B	0.00%	0.02%	0.05%	100%	99%
Class C	0.01%	-0.07%	-0.07%	99%	97%
Class E	0.00%	0.05%	-0.02%	99%	98%
<b>Overall</b>	0.00%	0.02%	0.01%	99%	98%
Class D	-0.02%	0.03%	-0.06%	100%	104%
Class F	0.00%	-0.05%	0.01%	100%	104%

	Random access Main10				
	Over VTM-6.0			EncT	DecT
	Y	U	V		
Class A1	0.01%	0.05%	-0.01%	99%	100%
Class A2	0.01%	0.07%	0.04%	100%	100%
Class B	-0.01%	0.08%	-0.11%	99%	100%
Class C	-0.01%	0.08%	-0.11%	100%	98%
Class E					
<b>Overall</b>	0.00%	0.07%	-0.06%	100%	99%
Class D	0.01%	-0.29%	-0.18%	100%	105%
Class F	-0.01%	-0.12%	0.01%	100%	101%

	Low delay B Main10				
	Over VTM-6.0			EncT	DecT
	Y	U	V		
Class A1					
Class A2					
Class B	0.01%	0.31%	0.18%	100%	100%
Class C	0.01%	0.00%	0.02%	99%	98%
Class E	-0.19%	0.16%	0.51%	99%	100%
<b>Overall</b>	-0.04%	0.17%	0.21%	100%	99%
Class D	0.00%	0.10%	0.11%	100%	102%
Class F	0.00%	0.30%	0.30%	101%	98%

# Experimental results vs. VTM-6.0 (HDR)

## ■ HDR test (Proposed method)

All Intra								
Over VTM-6.0								
	wPSNR			PSNR			EncT	DecT
	Y	U	V	Y	U	V		
Class H1	0.00%	0.39%	0.45%	0.00%	0.39%	0.32%	99%	99%

Random Access								
Over VTM-6.0								
	wPSNR			PSNR			EncT	DecT
	Y	U	V	Y	U	V		
Class H1	0.01%	0.10%	0.12%	0.01%	0.19%	-0.20%	99%	99%

## ■ HDR test (JCCR off)

All Intra								
Over VTM-6.0								
	wPSNR			PSNR			EncT	DecT
	Y	U	V	Y	U	V		
Class H1	0.66%	4.05%	-3.31%	0.66%	3.34%	-6.18%	97%	99%

Random Access								
Over VTM-6.0								
	wPSNR			PSNR			EncT	DecT
	Y	U	V	Y	U	V		
Class H1	0.52%	2.88%	-3.92%	0.52%	2.68%	-6.49%	98%	99%

# Conclusions

- Benefits of the proposed method
  - *The per-sample chroma scaling computation could be saved by 50% when JCCR is enabled.*
  - *The number of clipping operations before the chroma scaling in LMCS is reduced by 50% when JCCR is enabled.*
- BD-rate changes are negligible
  - *AI: 0.00%/0.02%/0.01%*
  - *RA: 0.00%/0.07%/-0.06%*
  - *LDB: -0.04%/0.17%/0.21%*
- Recommendation: to adopt this method in the next VVC WD and VTM software.
- Thanks Dolby for cross-checking our proposal [JVET-P0712](#)