

Technicolor response to the CfE HDR category

JVET-G0022



technicolor



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Technology already investigated during the MPEG/JCT-VC HDR exploration work, implemented on top of JEM6.0

Basics: signal reshaping in the Y'CbCr 4:2:0 domain using luma-based cross-component scaling (no chroma upsampling, no conversion to linear-light)

MPEG/JCT-VC Exploratory Test Model

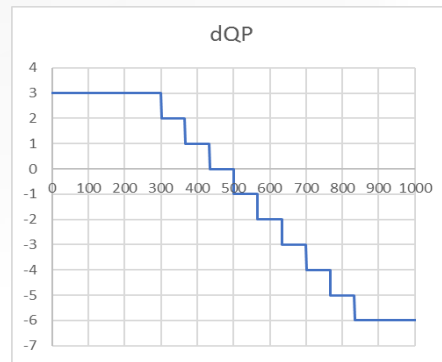
- Reshaping applied to the Y'CbCr 4:2:0 signal / Inverse reshaping at decoder
- 2 models:
 - 1. Separate reshaping of Y', Cb, Cr
 - 2. Reshaping of Y', luma-dependent scaling of Cb, Cr

HM / JEM HDR anchors

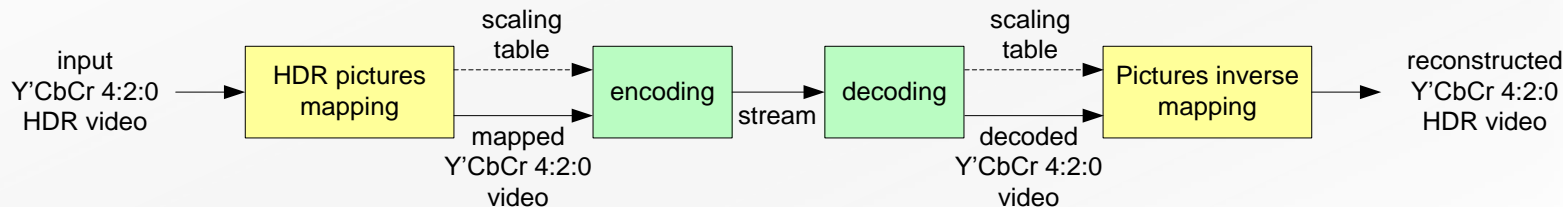
- Luma-based QP adaptation: dependent on CU/CTU average luma
- Non-normative: explicit coding of the dQP values
- Using a dQP table experimentally adjusted based on visual checks

JVET EE on Extended colour volume content coding

- Make the local QP adaptation process **normative**, by implementing in the decoder the **luma-based dQP derivation** (default dQP table or a table signaled in the stream)



Reshaping with luma-based cross-component scaling



1 single scaling table used for both mapping Y' and scaling Cb and Cr

Reproduces the behaviour of the luma-based QP adaptation with a finer accuracy (pixel-level)

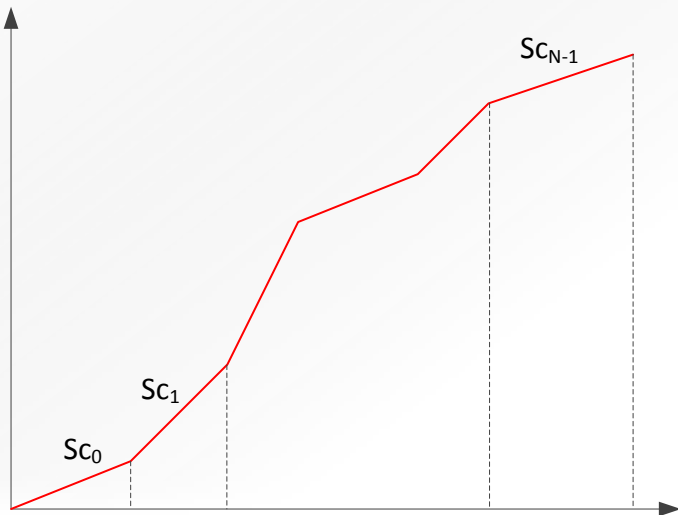
- In luma-based QP adaptation, the same luma-dependent dQP is used for scaling the luma and the chroma; this results in a luma-dependent cross-component scaling.
- In the proposed reshaping, the luma-dependent cross-component scaling is achieved at pixel-level.
- Main purpose: change the signal characteristics of Y'CbCr to improve the coding efficiency.

Solution overview

Range	$Y_0 - Y_1$	$Y_1 - Y_2$...	$Y_{N-2} - Y_{N-1}$
scaling	Sc_0	Sc_1	...	Sc_{N-1}

Luma mapping

■ $\text{map}(Y) = \text{map}(Y_i) + Sc_i * (Y - Y_i)$



Luma-based chroma scaling

■ $C_{\text{map}} = \text{offset} + Sc_i * (C_{\text{in}} - \text{offset})$

■ $C = C_b, C_r$

- i is the interval which the co-located luma sample belongs to:
 $Y \in [Y_i, Y_{i+1}]$

Objective metrics

- Implemented on top of JEM6.0
- Very simple tuning:
 - 1 table signaled per sequence
 - more elaborated tuning can be used to improve performance
- Luma-based dQP adaptation de-activated, Chroma QP adaptation activated

end-to-end metrics

(between the source sequence and the inverse mapped sequence)

versus HM	tPSNR Y	DE100	PSNRL100	wPSNR Y	wPSNR U	wPSNR V
Market3Clip4000r2	-23.8%	-41.8%	-28.2%	-27.8%	-51.2%	-48.8%
ShowGirl	-26.2%	-35.0%	-28.1%	-29.3%	-58.1%	-45.8%
EBU_04_Hurdles	-33.6%	-54.1%	-38.7%	-37.1%	-67.0%	-56.9%
EBU_06_Starting	-31.2%	-33.3%	-33.9%	-32.8%	-34.5%	-51.7%
Cosmos1	-24.6%	-33.7%	-22.5%	-25.2%	-68.2%	-100.0%
Overall	-27.9%	-39.6%	-30.3%	-30.4%	-55.8%	-60.7%

versus JEM	tPSNR Y	DE100	PSNRL100	wPSNR Y	wPSNR U	wPSNR V
Market3Clip4000r2	0.3%	-6.4%	-4.1%	-3.0%	-9.1%	-13.1%
ShowGirl	-1.8%	-13.7%	-2.6%	-2.3%	2.0%	-25.4%
EBU_04_Hurdles	-1.9%	-10.0%	-3.7%	-3.0%	-12.8%	-11.5%
EBU_06_Starting	-2.4%	3.5%	-3.4%	-2.7%	3.8%	-19.4%
Cosmos1	-1.7%	-4.1%	3.0%	-0.6%	6.9%	-34.4%
Overall	-1.5%	-6.1%	-2.2%	-2.3%	-1.9%	-20.8%

Illustration of reshaped pictures

Top: BT.2100 PQ version / Bottom: reshaped version



Proposed reshaping has similarities with luma-based QP adaptation of HDR anchors HM and JEM

Main advantages of the proposed approach:

- **pixel-level accuracy**, instead of block-level accuracy for the luma-based QP adaptation
- **Not intrusive in the core decoding process** - normative parts correspond to the scaling table signalling and to the inverse reshaping process
- Objective results, using a very simple tuning, already show that this is **beneficial for the considered HDR metrics**