



JCTVC-X0050

AHG13: $IC_T C_P$ Compression Using HEVC Main 10

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Background

- $IC_T C_P$ colour representation is specified in the ITU-R Draft New Recommendation BT.[HDR-TV].
 - JCTVC-W0050: overview of $IC_T C_P$
 - Better Performance for Large Color Volumes
 - Constant Intensity
 - Constant Hues
 - Perceptually Uniform
 - Improved Baseband Quantization
 - Same Operations as NCL Y'CbCr
 - Iso-luminance: no need to use close-loop luma adjustment to fix 4:2:0 distortion.
 - $IC_T C_P$ white paper: <http://www.dolby.com/us/en/technologies/dolby-vision/ICtCp-white-paper.pdf>
- **This proposal: shows simulation results that $IC_T C_P$ signal can be compressed well using HEVC Main 10 codec.**

Proposed Setting

- Encoder Design
 - Use HDR Anchor 3.2 HM encoder software
 - Change configuration parameters to fit $I C_T C_P$ signal
 - Follow luma/chroma bitrate allocation behavior of Y'CbCr PQ => same QP used as Anchor
- Anchor 3.2 HM encoder: two changes compared to HM16.7
 - A specific chroma QP offset process is applied to better control the chroma shifting;
 - A specific control of the luma delta QP is applied to better balance the bitrate between dark and bright areas.
- $I C_T C_P$ signal characteristics:
 - I component has similar variance level as Y' => no change in luma delta QP setting
 - $C_T C_P$ component has higher variance than CbCr => modify configuration parameters for chroma QP Offset.

Chroma QP Offset Configuration Setting

- Chroma QP Offset algorithm in HM Anchor 3.2

$CbOffset = clip3(-12, 0, round(CbQpScale \cdot (QpScale \cdot baseQP + QpOffset)))$

$CrOffset = clip3(-12, 0, round(CrQpScale \cdot (QpScale \cdot baseQP + QpOffset)))$

$Act_CbQpOffset = clip3(-12, 12, CbOffset + CbQpOffset)$

$Act_CrQpOffset = clip3(-12, 12, CrOffset + CrQpOffset)$

Chroma QP offset parameters for Y'CbCr PQ signal

Type	QpScale	QpOffset	CbQpScale	CrQpScale	CbQPoffset	CrQPoffset
709	-0.46	9.26	1.14	1.79	0	0
P3	-0.46	9.26	1.04	1.39	0	0

Chroma QP offset parameters for $IC_T C_P$ PQ signal

Type	QpScale	QpOffset	CbQpScale	CrQpScale	CbQPoffset	CrQPoffset
709	-0.46	10	0.9	1.6	6	6
P3	-0.46	10	0.5	0.9	8	7

Simulation Setting

- Conversion: HDRTools-0.11 dev branch

Configuration parameters for conversion in HDRTools

	Y'CbCr PQ	IC _T C _P PQ
ColorSpace	1	10
ColorPrimaries	0	9
ClosedLoopConversion	5	0

No need of closedloop luma adjustment;
Significant conversion complexity reduction!
(speed up at least 3x)

- HM Anchor 3.2 configuration:

- Chroma QP Offset setting
- Luma dQP
- VUI setting

VUI parameters in HM encoding

	Y'CbCr PQ	IC _T C _P PQ
MatrixCoefficients	9	14

Compression Results

- Objective metrics: Some **BD-rate savings** in tPSNRY (-0.8%), DE100 (-12.3%), PSNRL100 (-0.9%) are observed:
 - Gains are simultaneously found in both texture (psnrY, psnrL) and color (DE), not trading one for the other;

		X	Y	Z	XYZ	tOSNR-XYZ	DE100	MD100	PSNRL100
class A	FireEaterClip4000r1	-17.3%	-6.2%	77.4%	6.4%	-0.7%	-21.6%	-15.2%	-7.2%
	Market3Clip4000r2	-2.2%	-0.2%	-0.7%	-1.0%	-1.3%	-13.4%	-89.0%	0.0%
	SunRise	-4.4%	0.1%	-0.6%	-1.7%	-4.4%	-41.7%	-18.8%	-0.9%
class B	BikeSparklers cut 1	-5.5%	-1.6%	6.6%	-0.1%	-1.6%	-6.9%	-14.6%	-1.2%
	BikeSparklers cut 2	-5.2%	-1.3%	8.2%	0.2%	-0.8%	-4.6%	-4.8%	-0.7%
	GarageExit	-6.2%	-1.9%	2.1%	-1.8%	-1.6%	-2.4%	5.6%	-2.0%
class C	ShowGirl2Teaser	-6.5%	-0.6%	4.1%	-1.0%	-1.8%	-9.7%	-10.6%	-1.1%
class D	STEM_MagicHour cut 1	-8.9%	-0.6%	5.8%	0.4%	0.0%	-12.9%	-10.5%	-0.8%
	STEM_MagicHour cut 2	-5.3%	0.2%	2.3%	-0.2%	-0.4%	-7.1%	-12.2%	0.0%
	STEM_MagicHour cut 3	-5.4%	-0.5%	7.9%	2.6%	2.9%	-3.2%	-2.9%	-0.6%
	STEM_WarmNight cut 1	-6.9%	-0.2%	7.7%	1.3%	0.7%	-17.1%	-5.4%	-0.3%
	STEM_WarmNight cut 2	-11.2%	-1.6%	29.3%	8.8%	9.4%	-15.5%	-36.4%	-1.1%
class G	BalloonFestival	-0.7%	0.4%	2.9%	1.1%	1.6%	4.5%	-34.0%	-0.2%
class H	EBU_04_Hurdles	-6.0%	0.5%	-0.4%	-1.6%	-2.7%	-18.3%	-1.6%	0.9%
	EBU_06_Start	-4.2%	1.6%	-7.5%	-3.6%	-4.8%	-14.9%	-29.2%	1.6%
	Overall	-6.4%	-0.8%	9.7%	0.7%	-0.4%	-12.3%	-18.7%	-0.9%

- Subjective checking:
 - With the proposed setting, $IC_{\tau}C_p$ signal has at least **comparable subjective quality** as Anchor.

Conclusion

- $IC_T C_p$ signal can be compressed well using HEVC Main 10.
 - Encoder settings are derived based on the rate allocation behavior in encoding Y'CbCr PQ signal as in Anchor v3.2.
 - Without further optimization, coding efficiency of encoding $IC_T C_p$ signal is at least comparable to that of encoding Y'CbCr PQ signal.

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Q & A

