

Encoder Optimization for HDR/WCG Coding

Yuwen He

Yan Ye

Louis Kerofsky



Overview

- Background
- Encoder Optimization
 - Deblocking filter parameter selection
 - Chroma quantization parameter offset adjustment
- Simulation results
- Conclusions

Background

- Three encoder optimization methods were proposed in m37223 in last meeting (Oct., 2015) compared to CfE anchor
 - Weighted prediction parameter estimation
 - Deblocking filter parameter selection
 - Chroma quantization parameter offset adjustment
- CE1 AnchorV3.0 (released on Nov. 21, 2015) has a lot of improvements compared to CfE anchor
 - Test sequences and test condition changes (remove Autowelding, add SunRise, 2 EBU sequences)
 - Chroma QP offset
 - Luma dQP at CTU level based on CTU average luminance
- Tested those methods in CE1 AnchorV3.0

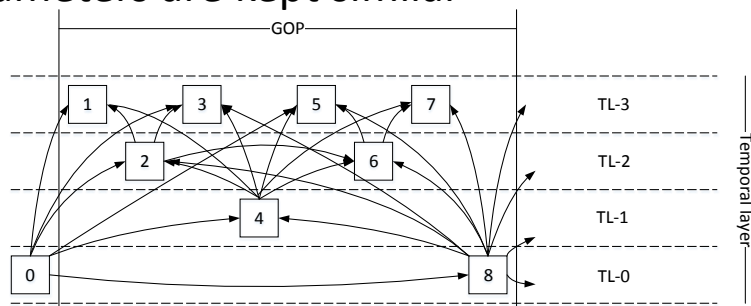
Deblocking filter parameter selection

- The deblocking filter parameters, beta offset “slice_beta_offset_div2” and tc offset “slice_tc_offset_div2”, are signaled in slice header
- The beta offset and tc offset are selected to minimize the distortion between deblock picture and original picture:

$$(BO, TO)_{\text{Opt}} = \arg_{(BO, TO)} \min \text{Distortion}(DB(\text{rec}, BO, TO), \text{org}_{YCbCr})$$

where BO is beta offset and TO is tc offset

- Instead of applying parameter search in a brute force manner for each possible (BO, TO) pair, early termination is applied to accelerate the parameter searching process
- The hierarchical coding structure in random access coding configuration is considered to avoid flickering
 - For those pictures at the same temporal layer coded with same QP, their deblocking parameters are kept similar



Chroma quantization parameter offset adjustment

- CE1 AnchorV3.0 calculates chroma QP offset based on the QP at sequence level

$$QPc_offset = Round(S2*(S1*QP + O))$$

where QP is sequence level luma QP, $S2/S1$ and O are the scaling factor and offset applied in CE1 anchor

- The additional chroma QP offset adjustment is added based on temporal level

$$QPc_offset = Round(S2*(S1*QP + O)) + QPc_adj(TL_Idx)$$

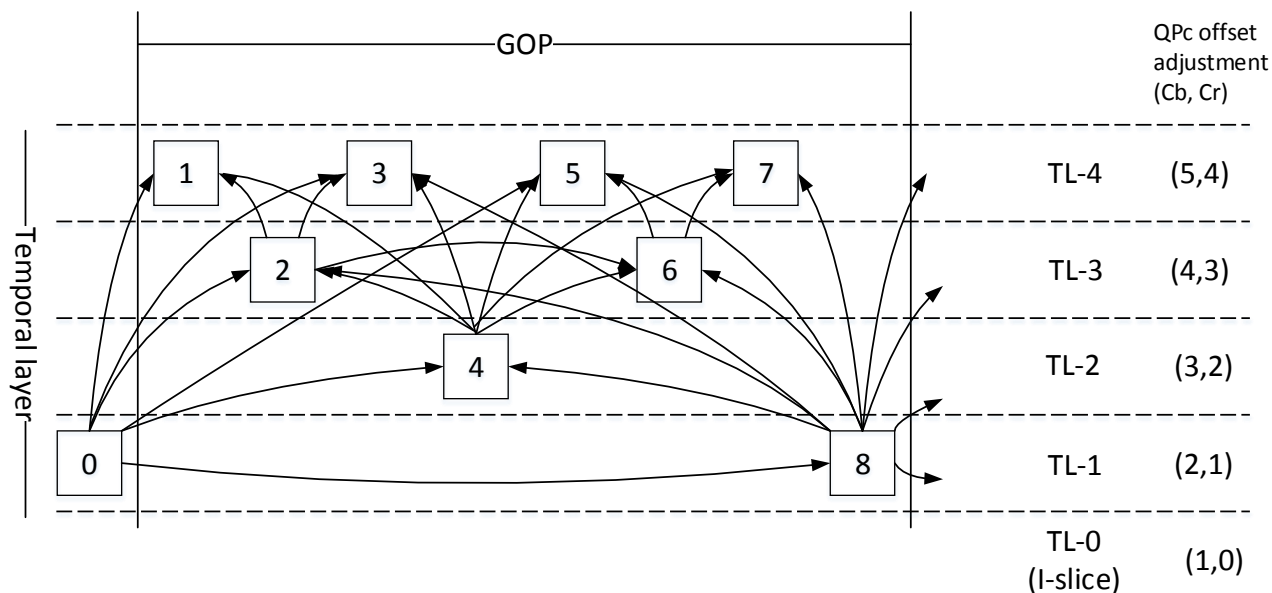
Where TL_Idx is the temporal level the picture belongs to

- The final chroma QP is calculated as

$$QPc = QP + Clip(-12, 0, QPc_offset)$$

Chroma quantization parameter offset adjustment

- The temporal level chroma QP offset adjustment allocates more bits to pictures at lower temporal level than to those at higher temporal level
- It can save bits for luminance coding
- In simulation, the additional chroma QP offset adjustments (Cb, Cr) are set as:



Simulation results

- Test1
 - Deblocking parameter selection + chroma QP offset adjustment
- Test2
 - Deblocking parameter selection

Simulation results (Test1 vs. CE1 AnchorV3.0)

		X	Y	Z	XYZ	tOSNR- XYZ	DE100	PSNRL100
class A	FireEaterClip4000r1	1.1%	-0.8%	9.3%	2.6%	5.3%	6.0%	-0.3%
	Market3Clip4000r2	-1.0%	-1.2%	2.7%	0.3%	0.9%	11.6%	-1.5%
	SunRise	-1.1%	-1.1%	2.5%	0.3%	1.6%	7.4%	-0.9%
class B	BikeSparklers cut 1	-3.0%	-3.5%	6.6%	0.0%	0.3%	8.4%	-3.3%
	BikeSparklers cut 2	-2.7%	-3.6%	8.3%	0.2%	0.9%	11.0%	-3.3%
	GarageExit	-1.7%	-2.5%	7.0%	1.2%	2.3%	12.8%	-2.3%
class C	ShowGirl2Teaser	-0.9%	-1.3%	4.7%	0.8%	3.1%	9.3%	-1.1%
class D	StEM_MagicHour cut 1	-0.8%	-1.2%	4.9%	1.8%	2.1%	5.1%	-1.1%
	StEM_MagicHour cut 2	-1.3%	-2.1%	5.4%	1.6%	2.4%	10.0%	-1.8%
	StEM_MagicHour cut 3	-0.7%	-1.8%	6.2%	2.4%	3.0%	9.5%	-1.6%
	StEM_WarmNight cut 1	-0.6%	-1.1%	4.1%	1.2%	1.7%	6.1%	-1.0%
	StEM_WarmNight cut 2	-0.6%	-1.1%	5.0%	1.7%	2.1%	3.7%	-1.1%
class G	BalloonFestival	-1.0%	-2.1%	6.0%	1.6%	3.2%	11.7%	-2.1%
class H	EBU_04_Start	-1.7%	-2.5%	4.3%	0.6%	1.7%	17.5%	-2.3%
	EBU_06_Hurdles	-2.4%	-3.2%	4.4%	0.0%	0.6%	11.7%	-3.1%
	Overall	-1.2%	-1.9%	5.4%	1.1%	2.1%	9.5%	-1.8%

Simulation results (Test2 vs. CE1 AnchorV3.0)

		X	Y	Z	XYZ	tOSNR- XYZ	DE100	PSNRL100
class A	FireEaterClip4000r1	-0.1%	-0.2%	-0.5%	-0.2%	-0.2%	0.0%	-0.2%
	Market3Clip4000r2	-0.4%	-0.4%	-0.5%	-0.4%	-0.6%	0.1%	-0.6%
	SunRise	-0.7%	-0.7%	-0.3%	-0.5%	-0.4%	1.6%	-0.6%
class B	BikeSparklers cut 1	-0.7%	-0.7%	-0.7%	-0.7%	-0.5%	-0.5%	-0.4%
	BikeSparklers cut 2	-0.6%	-0.7%	-1.1%	-0.8%	-0.6%	-0.4%	-0.4%
	GarageExit	-0.3%	-0.2%	-0.5%	-0.3%	-0.2%	-0.2%	-0.1%
class C	ShowGirl2Teaser	-0.3%	-0.2%	-0.9%	-0.5%	0.0%	-0.1%	-0.2%
class D	StEM_MagicHour cut 1	-0.3%	-0.2%	0.0%	-0.2%	-0.1%	0.1%	-0.1%
	StEM_MagicHour cut 2	-0.9%	-0.8%	-0.5%	-0.7%	-0.6%	-0.5%	-0.6%
	StEM_MagicHour cut 3	-0.6%	-0.6%	0.3%	-0.1%	0.1%	0.0%	-0.3%
	StEM_WarmNight cut 1	-0.4%	-0.4%	-0.2%	-0.3%	-0.3%	0.0%	-0.2%
	StEM_WarmNight cut 2	0.0%	-0.1%	0.3%	0.1%	0.1%	0.4%	0.0%
class G	BalloonFestival	-0.3%	-0.4%	-0.3%	-0.3%	-0.3%	-0.3%	-0.2%
class H	EBU_04_Start	-0.6%	-0.4%	-0.5%	-0.5%	-0.3%	-0.5%	-0.2%
	EBU_06_Hurdles	-0.5%	-0.4%	-0.3%	-0.4%	-0.4%	-0.2%	-0.4%
	Overall	-0.5%	-0.4%	-0.4%	-0.4%	-0.3%	0.0%	-0.3%

Simulation results

- Subjective viewing for Test1
 - Visible subjective quality improvements in sequential playback comparison for the following sequences at rate R4:
 - SunRise, WarmNight, BalloonFestival, BikeSparklers
 - In toggle mode, the improvements are more visible for ShowGirl at rate R4
 - Ericsson reported more blockings in Market R1 for Test1
- Subjective viewing for Test2
 - The improvements can be found in toggle mode for the following sequences at rate R4:
 - WarmNight, BikeSparklers, ShowGirl