

JCTVC-G509

Support of ChromaQPOffset in HEVC

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Introduction

- ChromaQPOffset in AVC standard is a useful tool for adjusting Luma/Chroma quality balance.
- We would like it be supported also with HEVC.
- Same method as the one in AVC has been implemented into HM-4.0.
- 2 kind of tests have been conducted:
 - Test 1: Uniform Offset: $CQO=CQO2=\pm 2$ throughout the image
 - Test 2: Adaptive Offset: $CQO=CQO2=\{2, 1, 0, -1, -1\}$ depends on hierarchy of temporal layer

CQO=CQO2=-2

	All Intra HE			All Intra LC		
	Y	U	V	Y	U	V
Class A	0.9%	-4.1%	-4.0%	0.9%	-4.3%	-4.7%
Class B	1.1%	-5.7%	-5.6%	1.1%	-6.1%	-6.3%
Class C	1.1%	-4.8%	-4.8%	1.2%	-5.3%	-5.4%
Class D	1.1%	-4.7%	-4.9%	1.2%	-5.3%	-5.6%
Class E	0.5%	-4.5%	-4.4%	0.7%	-6.3%	-5.9%
Class F						
Overall	1.0%	-4.8%	-4.8%	1.1%	-5.5%	-5.6%
	1.0%	-4.7%	-4.7%	1.1%	-5.2%	-5.3%
Enc Time[%]	100%			100%		
Dec Time[%]	100%			101%		

	Random Access HE			Random Access LC		
	Y	U	V	Y	U	V
Class A	0.5%	-8.8%	-9.7%	0.6%	-8.4%	-8.7%
Class B	0.7%	-9.8%	-9.7%	0.8%	-10.3%	-10.3%
Class C	0.7%	-7.4%	-7.2%	0.8%	-8.1%	-7.5%
Class D	0.6%	-7.9%	-7.9%	0.8%	-9.0%	-8.6%
Class E						
Class F						
Overall	0.6%	-8.6%	-8.7%	0.8%	-9.0%	-8.9%
	0.6%	-8.4%	-8.5%	0.8%	-8.8%	-8.6%
Enc Time[%]	100%			100%		
Dec Time[%]	101%			102%		

	Low delay B HE			Low delay B LC		
	Y	U	V	Y	U	V
Class A						
Class B	0.5%	-5.1%	-5.0%	0.7%	-6.3%	-6.8%
Class C	0.5%	-3.8%	-3.9%	0.7%	-4.5%	-4.8%
Class D	0.4%	-4.5%	-4.6%	0.6%	-5.8%	-6.1%
Class E	0.2%	-7.1%	-5.0%	0.4%	-11.3%	-8.7%
Class F						
Overall	0.4%	-5.0%	-4.6%	0.6%	-6.7%	-6.5%
	0.4%	-4.9%	-4.5%	0.6%	-6.4%	-6.1%
Enc Time[%]	99%			100%		
Dec Time[%]	104%			102%		

CQO=CQO2=+2

	All Intra HE			All Intra LC		
	Y	U	V	Y	U	V
Class A	-0.8%	7.0%	7.3%	-0.8%	7.9%	8.1%
Class B	-1.0%	9.8%	9.9%	-1.0%	10.5%	10.9%
Class C	-1.0%	8.2%	8.1%	-1.1%	9.0%	9.0%
Class D	-1.0%	8.0%	8.1%	-1.0%	9.3%	9.4%
Class E	-0.4%	7.1%	6.8%	-0.6%	8.9%	9.0%
Class F						
Overall	-0.9%	8.2%	8.2%	-0.9%	9.2%	9.4%
	-0.9%	8.5%	8.5%	-0.9%	9.6%	9.8%
Enc Time[%]	100%			99%		
Dec Time[%]	100%			101%		

	Random Access HE			Random Access LC		
	Y	U	V	Y	U	V
Class A	-0.3%	10.1%	11.4%	-0.5%	10.4%	11.5%
Class B	-0.5%	11.8%	12.2%	-0.7%	12.3%	13.1%
Class C	-0.5%	8.5%	8.2%	-0.6%	9.2%	9.0%
Class D	-0.4%	9.3%	9.0%	-0.6%	10.6%	10.4%
Class E						
Class F						
Overall	-0.4%	10.0%	10.3%	-0.6%	10.7%	11.1%
	-0.4%	10.2%	10.4%	-0.6%	10.8%	11.2%
Enc Time[%]	100%			100%		
Dec Time[%]	101%			97%		

	Low delay B HE			Low delay B LC		
	Y	U	V	Y	U	V
Class A						
Class B	-0.4%	6.9%	6.7%	-0.6%	9.2%	10.0%
Class C	-0.4%	4.9%	4.4%	-0.7%	6.9%	7.0%
Class D	-0.3%	5.7%	5.6%	-0.6%	9.0%	8.8%
Class E	0.0%	8.1%	8.3%	-0.4%	10.3%	11.7%
Class F						
Overall	-0.3%	6.3%	6.2%	-0.6%	8.8%	9.3%
	-0.3%	6.4%	6.2%	-0.6%	8.7%	9.3%
Enc Time[%]	99%			100%		
Dec Time[%]	87%			102%		

Thanks Panasonic for Cross-checking! (JCTVC-G759)

Adaptive Offset: YUV separate BD-rate

	Intra			Intra LoCo		
	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate
Class A	0.43	-1.94	-2.63	0.42	-0.96	-1.46
Class B	0.51	-3.02	-3.07	0.51	-2.97	-2.79
Class C	0.50	-2.02	-1.81	0.56	-1.92	-1.79
Class D	0.49	-2.12	-1.77	0.56	-2.06	-1.82
Class E	0.21	-1.10	-0.86	0.24	-1.22	-0.75
All	0.44	-2.14	-2.14	0.47	-1.91	-1.82
Enc Time[%]	101%			100%		
Dec Time[%]	100%			100%		

	Random access			Random access LoCo		
	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate
Class A	0.2	-4.3	-4.6	0.3	-2.9	-2.9
Class B	0.3	-4.2	-5.2	0.4	-4.1	-4.8
Class C	0.3	-3.4	-3.5	0.4	-3.5	-3.4
Class D	0.3	-4.1	-4.2	0.4	-4.1	-3.9
Class E						
All	0.3	-4.0	-4.4	0.3	-3.7	-3.8
Enc Time[%]	100%			100%		
Dec Time[%]	100%			100%		

	Low delay B			Low delay B LoCo		
	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate
Class A						
Class B	0.3	-2.9	-3.0	0.4	-2.8	-2.8
Class C	0.3	-2.2	-2.3	0.4	-1.9	-2.4
Class D	0.2	-2.7	-2.5	0.3	-2.4	-2.4
Class E	0.2	-3.6	-3.0	0.3	-5.6	-3.8
All	0.2	-2.8	-2.7	0.3	-3.0	-2.8
Enc Time[%]	100%			100%		
Dec Time[%]	100%			100%		

	Low delay P			Low delay P LoCo		
	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate
Class A						
Class B	0.3	-3.2	-3.1	0.4	-3.1	-3.2
Class C	0.3	-2.3	-2.5	0.3	-2.5	-2.3
Class D	0.2	-2.7	-3.2	0.2	-2.7	-2.7
Class E	0.1	-3.9	-3.5	0.4	-6.8	-4.7
All	0.2	-3.0	-3.0	0.3	-3.5	-3.1
Enc Time[%]	100%			100%		
Dec Time[%]	100%			100%		

Adaptive Offset: Joint YUV=6:1:1 BD-rate

	Random access	Random Access LoCo
	YUV BD-rate	YUV BD-rate
Class A	-0.3	-0.1
Class B	-0.6	-0.4
Class C	-0.4	-0.3
Class D	-0.4	-0.4
Class E		
All	-0.4	-0.3

	Low delay B	Low delay B LoCo
	YUV BD-rate	YUV BD-rate
Class A		
Class B	-0.3	-0.2
Class C	-0.2	-0.1
Class D	-0.3	-0.2
Class E	-0.5	-0.5
All	-0.3	-0.3

	Low delay P	Low delay P LoCo
	YUV BD-rate	YUV BD-rate
Class A		
Class B	-0.4	-0.3
Class C	-0.3	-0.2
Class D	-0.3	-0.3
Class E	-0.6	-0.6
All	-0.4	-0.3

Thanks InterDigital for Cross-checking! (JCTVC-G907)

Conclusion

- It is recommended that ChromaQPOffset specified by AVC be adopted in HM-5.0.
- MediaTek/Sony will be able to volunteer providing both WD text and src.