

Non-CE3: Issue of Level mapping in transform skip residual (JVET-Q0143)

Y. Kato, K. Abe, T. Toma
Panasonic Corporation

Introduction

In transform skip residual coding of VTM7.0, the level prediction which is called “level mapping” is performed.

Issue of level mapping:

This tool shows coding loss **for** natural video contents from ClassA to ClassE in all QP ranges, including lossless mode, whereas it shows the coding gain in screen contents in ClassF and ClassTGM.

Simulation results

■ Level mapping off in all sequences (Lossless)

	All Intra			Random Access			Low delay B		
	ratio		bit-rate savings	ratio		bit-rate savings	ratio		bit-rate savings
	VTM7	proposal		VTM7	proposal		VTM7	proposal	
Class A1	2.2	2.2	-0.24%	2.2	2.2	-0.29%			
Class A2	1.6	1.6	-0.06%	1.7	1.7	-0.12%			
Class B	2.2	2.2	-0.51%	2.3	2.4	-0.71%	2.3	2.4	-0.71%
Class C	1.9	2.0	-0.67%	2.4	2.5	-1.36%	2.4	2.5	-1.36%
Class D	1.9	1.9	-0.42%	2.8	2.8	-1.37%	2.7	2.8	-1.39%
Class E	2.8	2.8	-1.16%				3.1	3.2	-2.28%
Class F	5.3	5.3	0.00%	33.7	33.6	-0.67%	50.7	50.5	-0.73%
TGM	11.8	11.4	3.19%	107.1	99.3	5.80%	124.9	114.0	7.09%
Overall	2.1	2.1	-0.54%	2.2	2.2	-0.68%	2.6	2.6	-1.32%
Enc Time[%]	96%			97%			96%		
Dec Time[%]	98%			97%			95%		

There is interesting coding gain in natural video contents, whereas coding loss is seen in screen contents.

Simulation results

■ Level mapping off in all sequences (CTC)

All Intra Main10					
Over VTM-7.0					
	Y	U	V	EncT	DecT
Class A1	-0.01%	-0.04%	0.00%	101%	101%
Class A2	0.00%	-0.02%	-0.03%	101%	101%
Class B	0.00%	-0.01%	-0.07%	101%	102%
Class C	-0.02%	0.05%	0.14%	101%	101%
Class E	0.01%	-0.05%	-0.03%	101%	100%
Overall	0.00%	-0.01%	0.00%	101%	101%
Class D	-0.01%	0.00%	-0.04%	100%	100%
Class F	0.37%	0.35%	0.53%	100%	101%
TGM	0.78%	0.93%	0.87%	98%	102%

There is some coding gain in natural video contents, whereas coding loss is seen in screen contents.

	Random Access Main 10						Low delay B Main10				
	Over VTM-7.0						Over VTM-7.0				
	Y	U	V	EncT	DecT		Y	U	V	EncT	DecT
Class A1	-0.01%	0.06%	0.03%	100%	100%	Class A1					
Class A2	-0.03%	-0.08%	0.04%	100%	100%	Class A2					
Class B	0.00%	0.03%	-0.10%	100%	100%	Class B	-0.01%	-0.45%	-0.01%	100%	100%
Class C	-0.03%	-0.01%	-0.08%	100%	100%	Class C	-0.01%	-0.35%	-0.01%	100%	100%
Class E						Class E	-0.06%	0.83%	-0.21%	100%	100%
Overall	-0.02%	0.00%	-0.04%	100%	100%	Overall	-0.02%	-0.10%	-0.06%	100%	100%
Class D	-0.06%	-0.22%	-0.23%	100%	99%	Class D	-0.04%	0.45%	-0.27%	99%	100%
Class F	0.24%	0.43%	0.32%	99%	99%	Class F	0.14%	0.24%	1.07%	100%	100%
TGM	0.51%	0.66%	0.68%	98%	100%	TGM	0.37%	0.43%	0.40%	99%	100%

Simulation results

■ Level mapping off in all sequences (LowQP)

	All Intra Main10				
	Over VTM-7.0(100Frm,4K,LowQP)				
	Y	U	V	EncT	DecT
Class A1	-0.03%	-0.03%	-0.04%	99%	99%
Class A2	0.00%	-0.01%	0.00%	99%	98%
Class B	-0.02%	-0.03%	-0.04%	99%	98%
Class C	-0.03%	-0.06%	-0.04%	99%	99%
Class E	-0.09%	-0.16%	-0.21%	99%	99%
Overall	-0.03%	-0.05%	-0.06%	99%	99%
Class D	0.01%	-0.07%	-0.04%	98%	95%
Class F	0.11%	0.17%	0.18%	99%	99%
TGM	1.48%	1.26%	1.34%	96%	100%

Same as CTC case.

	Random Access Main 10						Low delay B Main10				
	Over VTM-7.0(100Frm,4K,LowQP)						Over VTM-7.0(100Frm,4K,LowQP)				
	Y	U	V	EncT	DecT		Y	U	V	EncT	DecT
Class A1	#VALUE!	#VALUE!	#VALUE!	#NUM!	#NUM!	Class A1					
Class A2	#VALUE!	#VALUE!	#VALUE!	#NUM!	#NUM!	Class A2					
Class B	-0.01%	0.00%	-0.01%	99%	99%	Class B	-0.01%	-0.02%	0.00%	99%	98%
Class C	-0.02%	-0.06%	-0.04%	99%	99%	Class C	-0.01%	-0.01%	-0.01%	99%	99%
Class E						Class E	-0.01%	-0.01%	-0.01%	99%	98%
Overall	#VALUE!	#VALUE!	#VALUE!	#NUM!	#NUM!	Overall	-0.01%	-0.01%	-0.01%	99%	98%
Class D	-0.05%	-0.05%	-0.14%	99%	98%	Class D	-0.08%	-0.04%	-0.15%	99%	99%
Class F	0.06%	0.11%	0.03%	99%	98%	Class F	-0.06%	0.06%	0.05%	99%	99%
TGM	1.15%	1.14%	1.13%	98%	99%	TGM	0.93%	1.01%	1.02%	98%	101%

Proposal

Propose to introduce sps flag to switch if level mapping is enabled or not, and set this flag turned off from ClassA to ClassE.

Proposed TS syntax:

Pass 1: for (n=0, n <= numSbCoeff - 1 && CCB>=4, n++)

...

FirstPassBypassPos = n

Pass 2: for (n=0, n <= FirstPassBypassPos && CCB>=4, n++)

...

SecondPassBypassPos = n

Pass 3: for (n = 0; n <= numSbCoeff - 1; n++)

baseLevel = (n >= FirstpassBypassPos ? 0 : (n >= SecondpassBypassPos ? 2 : 10))

abs_remainder[n]

if (n < FirstpassBypassPos && **sps_level_mapping_enabled_flag**)
 inverse level mapping

Conclusion

- **Level mapping show coding loss in natural video contents in all QP ranges, especially for lossless mode.**

→ Propose to introduce sps flag to switch if level mapping is enabled or not, and set this flag turned off from ClassA to ClassE.

**Thank LGE for cross checking!
(JVET-Q0622)**

Additional information

■ Level mapping off in all sequences on CE3-1.2 vs CE3-1.2 (Lossless)

	All Intra			Random Access			Low delay B		
	ratio		bit-rate savings	ratio		bit-rate savings	ratio		bit-rate savings
	CE312	Q0143+CE312		CE312	Q0143+CE312		CE312	Q0143+CE312	
Class A1	2.3	2.3	-0.20%	2.3	2.3	-0.22%			
Class A2	1.7	1.7	-0.06%	1.8	1.8	-0.11%			
Class B	2.2	2.2	-0.40%	2.4	2.4	-0.59%	2.4	2.4	-0.59%
Class C	2.0	2.0	-0.50%	2.5	2.5	-1.13%	2.5	2.5	-1.14%
Class D	2.0	2.0	-0.29%	2.8	2.9	-1.15%	2.8	2.8	-1.17%
Class E	2.9	2.9	-0.98%				3.2	3.3	-1.97%
Class F	5.5	5.5	0.03%	34.8	34.6	-0.56%	52.1	51.8	-0.58%
TGM	12.3	11.9	2.62%	115.7	108.8	4.55%	136.0	124.2	6.41%
Overall	2.2	2.2	-0.43%	2.3	2.3	-0.57%	2.6	2.7	-1.12%
Enc Time[%]	#NUM!			#NUM!			#NUM!		
Dec Time[%]	#NUM!			#NUM!			#NUM!		

There is also interesting coding gain in natural video contents on CE3-1.2