

JCTVC-U0106 ON SIGNALING ADAPTIVE COLOR TRANSFORM AT TU LEVEL

Xiaoyu Xiu, Yuwen He, Yan Ye
InterDigital Communications Inc.
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Proposal

- Two inter-component de-correlation methods are supported in HEVC SCC draft 3
 - Inverse CCP and inverse ACT are operated at TU level
 - CCP parameters are signaled at TU level and ACT flag is signaled at CU level
- In this contribution, it is proposed to move the ACT flag to TU level
- Benefits
 - Improved ACT performance with finer granularity of switching between different color spaces
 - More harmonized design of ACT and CCP: both are signaled and operated at TU level

Proposal

transform_unit(x0, y0, xBase, yBase, log2TrafoSize, trafoDepth, blkIdx) {	Descriptor
.....	
if(cbfLuma cbfChroma) {	
xP = (x0 >> MinCbLog2SizeY) << MinCbLog2SizeY	
yP = (y0 >> MinCbLog2SizeY) << MinCbLog2SizeY	
nCbS = 1 << MinCbLog2SizeY	
if(residual_adaptive_colour_transform_enabled_flag && (CuPredMode[x0][y0] == MODE_INTER (PartMode[x0][y0] == PART_2Nx2N && intra_chroma_pred_mode[x0][y0] == 4) (intra_chroma_pred_mode[xP][yP] == 4 && intra_chroma_pred_mode[xP + nCbS/2][yP] == 4 && intra_chroma_pred_mode[xP][yP + nCbS/2] == 4 && intra_chroma_pred_mode[xP + nCbS/2][y0 + nCbS/2] == 4)))	
tu_ycgco_residual_flag	ae(v)
if(cu_qp_delta_enabled_flag && !IsCuQpDeltaCoded) {	
cu_qp_delta_abs	ae(v)
if(cu_qp_delta_abs)	
cu_qp_delta_sign_flag	ae(v)
}	
.....	
}	
}	

Encoder speedup

- Existing non-normative encoding methods and speedup logics of CU level ACT RD in SCM-4.0 are unchanged
- Encoder speedup for TU level ACT RD testing
 - TU level ACT test is only conducted for 8x8 and 16x16 CUs
 - For intra CUs, testing the second color space for one TU is skipped when the second color space RD cost of its parent TU is larger than that of the first color space
 - TU level ACT test is disabled for pictures at certain temporal layers for RA and LB
- The ACT flag is always **signaled at TU level**

Simulation results

- Lossy 444 results using **full frame IBC search**
- Average BD-rate savings
 - RGB: 0.2%, 0.1%, 0.3% for AI, RA and LB
 - YUV: 0.6%, 0.3%, 0.1% for AI, RA and LD

	All Intra			Random Access			Low delay B		
	G/Y	B/U	R/V	G/Y	B/U	R/V	G/Y	B/U	R/V
RGB, text & graphics with motion, 1080p & 720p	-0.5%	-0.9%	-0.8%	-0.5%	-1.0%	-0.8%	-0.5%	-0.5%	-0.4%
RGB, mixed content, 1440p & 1080p	0.0%	-0.5%	-0.5%	0.1%	-0.6%	-0.6%	-0.2%	-0.2%	-0.1%
RGB, Animation, 720p	-0.1%	-0.4%	-0.3%	-0.2%	-0.8%	-0.5%	-0.4%	-0.7%	-0.3%
RGB, camera captured, 1080p	0.0%	0.0%	0.0%	0.1%	-0.1%	0.1%	0.0%	-0.2%	0.0%
YUV, text & graphics with motion, 1080p & 720p	-0.3%	-0.9%	-0.7%	-0.3%	-0.7%	-0.7%	-0.2%	-0.2%	0.2%
YUV, mixed content, 1440p & 1080p	-0.5%	-1.1%	-1.1%	-0.4%	-1.0%	-1.3%	-0.1%	-0.2%	-0.9%
YUV, Animation, 720p	-1.3%	-3.8%	-3.5%	-0.6%	-2.9%	-2.4%	0.0%	-0.7%	-0.3%
YUV, camera captured, 1080p	-0.3%	-1.2%	-1.5%	-0.1%	-1.0%	-1.2%	-0.1%	-0.1%	-0.2%
Enc Time[%]	105%			102%			101%		
Dec Time[%]	101%			97%			97%		

Simulation results

- Lossy 444 results using [local IBC search](#)
- Average BD-rate savings
 - RGB: 0.2%, 0.1%, 0.2% for AI, RA and LB
 - YUV: 0.6%, 0.3%, 0.0% for AI, RA and LD

	All Intra			Random Access			Low delay B		
	G/Y	B/U	R/V	G/Y	B/U	R/V	G/Y	B/U	R/V
RGB, text & graphics with motion, 1080p & 720p	-0.2%	-0.6%	-0.5%	-0.4%	-0.8%	-0.6%	-0.4%	-0.5%	-0.2%
RGB, mixed content, 1440p & 1080p	0.0%	-0.4%	-0.4%	0.0%	-0.6%	-0.7%	-0.2%	-0.3%	-0.1%
RGB, Animation, 720p	-0.1%	-0.4%	-0.3%	-0.2%	-0.9%	-0.5%	-0.3%	-0.7%	-0.4%
RGB, camera captured, 1080p	0.0%	0.0%	0.0%	0.0%	-0.2%	0.1%	0.0%	-0.2%	0.1%
YUV, text & graphics with motion, 1080p & 720p	-0.4%	-0.8%	-0.8%	-0.3%	-0.7%	-0.6%	-0.1%	-0.1%	-0.3%
YUV, mixed content, 1440p & 1080p	-0.4%	-1.0%	-1.1%	-0.2%	-0.9%	-1.1%	0.1%	-0.7%	-0.6%
YUV, Animation, 720p	-1.3%	-3.9%	-3.5%	-0.4%	-2.7%	-2.4%	0.0%	-0.8%	-0.4%
YUV, camera captured, 1080p	-0.3%	-1.2%	-1.5%	-0.2%	-1.0%	-0.9%	0.0%	-0.2%	-0.2%
Enc Time[%]	104%			101%			100%		
Dec Time[%]	99%			99%			100%		

Simulation results

- Lossless 444 results
- Bit-rate savings
 - RGB: 0.4%, 1.1% and 1.0% for AI, RA and LB
 - YUV: 0.0%, 0.0% and 0.0% for AI, RA and LD

All Intra				Random Access				Low Delay B			
Bit-rate change (Total)	Bit-rate change (Average)	Bit-rate change (Min)	Bit-rate change (Max)	Bit-rate change (Total)	Bit-rate change (Average)	Bit-rate change (Min)	Bit-rate change (Max)	Bit-rate change (Total)	Bit-rate change (Average)	Bit-rate change (Min)	Bit-rate change (Max)
-0.8%	-0.9%	-2.2%	-0.3%	-1.5%	-1.4%	-3.6%	-0.5%	-1.2%	-1.1%	-2.7%	-0.1%
-0.4%	-0.3%	-0.5%	-0.3%	-1.2%	-1.2%	-1.5%	-0.8%	-1.0%	-1.0%	-1.5%	-0.5%
-0.2%	-0.2%	-0.2%	-0.2%	-1.5%	-1.5%	-1.5%	-1.5%	-1.3%	-1.3%	-1.3%	-1.3%
-0.1%	-0.1%	-0.1%	0.0%	-0.3%	-0.3%	-0.3%	-0.2%	-0.3%	-0.2%	-0.3%	-0.2%
-0.1%	-0.1%	-0.2%	0.0%	0.0%	0.0%	-0.1%	0.0%	-0.1%	0.0%	-0.2%	0.0%
0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.1%	-0.1%	-0.1%	-0.1%
0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
105%				100%				99%			
94%				94%				92%			

Thanks to Microsoft for the cross-check!

Closing remarks

- It is proposed to signal the ACT flag at TU level
- Benefits
 - Improved SCC efficiency
 - More harmonized design of ACT and CCP
- Suggest to adopt into SCC