

JVET-K0127

CE6: AMT and NSST complexity reduction (CE6-3.3)

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- AMT and NSST provide interesting gains, but the encoding runtimes are significantly increased.
 - AI : about 5.3% gain with 580% encoding runtime (VTM configuration)
 - RA : about 3.1% gain with 260% encoding runtime (VTM configuration)
 - Simultaneous usage of AMT and NSST is likely to cause throughput issue since it is difficult to apply a fast algorithm to some AMT transforms.
- ➡ Need to reduce the complexity of AMT and NSST combination

Proposed method

(restriction1) NSST is used only when DCT2 is used as primary transform.

(restriction2) DST7 is selected as AMT when width or height is less than or equal to 4.

block size		AMT (primary trans)			NSST (secondary trans)
		amt_flag	horizontal	vertical	
width <= 4	height <= 4	0	DCT2	DCT2	enable 4x4NSST
		1	DST7	DST7	None
width <= 4	height > 4	0	DCT2	DCT2	enable 4x4NSST
		1	DST7	DCT5/DCT8/DST1/DST7	None
width > 4	height <= 4	0	DCT2	DCT2	enable 4x4NSST
		1	DCT5/DCT8/DST1/DST7	DST7	None
width > 4	height > 4	0	DCT2	DCT2	enable 4x4NSST
		1	DCT5/DCT8/DST1/DST7	DCT5/DCT8/DST1/DST7	None

Note : Signaling of the syntax is skipped when it is not needed.

Simulation results (CE6-3.3)

Anchor : VTM configuration (BMS-1.1 software)

Test : Enable AMT and NSST using restriction 1 and 2

	All Intra Main10					Random Access Main 10					Low delay B Main10				
	Over VTM-1.1					Over VTM-1.1					Over VTM-1.1				
	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
Class A1	-4.56%	-5.17%	-5.55%	332%	121%	-2.62%	-3.56%	-3.74%	200%	112%					
Class A2	-3.96%	-4.12%	-4.03%	344%	117%	-2.44%	-1.68%	-1.28%	176%	107%					
Class B	-4.34%	-3.71%	-3.70%	351%	122%	-2.95%	-2.44%	-2.72%	186%	108%	-2.07%	-0.22%	-0.15%	184%	112%
Class C	-4.61%	-3.30%	-3.74%	370%	112%	-2.68%	-1.53%	-1.98%	191%	105%	-1.47%	0.39%	0.08%	177%	107%
Class E	-5.63%	-4.55%	-4.53%	313%	120%						-1.52%	0.98%	0.21%	157%	106%
Overall	-4.59%	-4.07%	-4.21%	344%	118%	-2.71%	-2.27%	-2.44%	188%	108%	-1.73%	0.28%	0.01%	174%	109%
Class D	-4.58%	-2.59%	-2.92%	386%	111%	-2.46%	-0.97%	-1.21%	187%	103%	-1.32%	0.62%	0.27%	162%	104%
Class F	-2.95%	-2.40%	-2.43%	330%	109%	-2.06%	-1.31%	-1.31%	206%	106%	-1.33%	-0.51%	-0.66%	186%	105%

Simulation results (CE6-3.3)

Anchor : BMS configuration (BMS-1.1 software)

Test : Using restriction 1 and 2

	All Intra Main10					Random Access Main 10					Low delay B Main10				
	Over BMS-1.1					Over BMS-1.1					Over BMS-1.1				
	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
Class A1	0.51%	0.79%	0.95%	62%	98%	0.25%	0.59%	0.72%	77%	100%	0.02%	0.49%	0.41%	88%	100%
Class A2	0.59%	0.69%	0.86%	60%	97%	0.15%	0.63%	0.55%	81%	100%					
Class B	0.50%	0.86%	0.76%	59%	98%	0.22%	1.06%	0.75%	79%	101%					
Class C	0.67%	0.28%	0.41%	57%	98%	0.39%	0.65%	0.14%	77%	102%					
Class E	0.73%	0.60%	0.69%	63%	100%	0.26%	0.77%	0.54%	78%	101%	0.11%	-0.44%	0.83%	97%	100%
Overall	0.59%	0.65%	0.72%	60%	98%						0.06%	0.19%	0.39%	90%	100%
Class D	0.74%	0.22%	0.28%	54%	97%						0.08%	-0.47%	-0.46%	91%	101%
Class F	0.46%	0.20%	0.14%	57%	99%						0.03%	0.58%	0.11%	85%	100%

Simulation results (restriction 1 only)

Anchor : BMS configuration (BMS-1.1 software)

Test : Using restriction 1 only

	All Intra Main10					Random Access Main 10					Low delay B Main10				
	Over BMS-1.1					Over BMS-1.1					Over BMS-1.1				
	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
Class A1	0.48%	0.83%	1.01%	64%	99%	0.23%	0.66%	0.85%	77%	100%	0.02%	0.41%	0.62%	89%	99%
Class A2	0.56%	0.72%	0.84%	62%	97%	0.13%	0.61%	0.67%	82%	99%					
Class B	0.49%	0.83%	0.73%	61%	99%	0.22%	1.00%	0.82%	80%	100%					
Class C	0.60%	0.32%	0.51%	59%	99%	0.38%	0.61%	0.36%	79%	100%					
Class E	0.70%	0.54%	0.55%	64%	100%	0.25%	0.75%	0.67%	79%	101%	0.03%	-0.17%	0.78%	97%	100%
Overall	0.56%	0.65%	0.72%	62%	99%						0.02%	0.25%	0.50%	91%	100%
Class D	0.66%	0.25%	0.40%	57%	101%						0.09%	0.03%	0.46%	92%	101%
Class F	0.36%	0.35%	0.04%	59%	100%						-0.02%	0.42%	0.42%	85%	102%

➡ Restriction 1 has the majority effect in CE6-3.3 proposal.

Additional information (encoder algorithm only)

■ Problem

BMS has an option for fast AMT encoding algorithm called “EMTFast”.
But the fast algorithm for intra CU is enabled under AI condition only.

■ Simulation results

Anchor : BMS configuration (BMS-1.1 software)

Test : Enable the fast algorithm for intra CU also under RA and LDB conditions

	All Intra Main10					Random Access Main 10					Low delay B Main10				
	Over BMS-1.1					Over BMS-1.1					Over BMS-1.1				
	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
Class A1	0.00%	0.00%	0.00%	99%	100%	0.10%	0.05%	0.11%	89%	100%					
Class A2	0.00%	0.00%	0.00%	99%	100%	0.02%	0.08%	0.04%	93%	100%					
Class B	0.00%	0.00%	0.00%	100%	99%	0.02%	-0.10%	0.01%	92%	100%	-0.01%	0.30%	0.16%	95%	100%
Class C	0.00%	0.00%	0.00%	100%	99%	0.07%	0.05%	-0.15%	94%	100%	-0.02%	0.08%	-0.13%	96%	100%
Class E	0.00%	0.00%	0.00%	100%	100%						-0.07%	0.06%	0.41%	99%	100%
Overall	0.00%	0.00%	0.00%	100%	100%	0.05%	0.01%	-0.01%	92%	100%	-0.03%	0.17%	0.13%	96%	100%
Class D	0.00%	0.00%	0.00%	100%	99%	0.08%	0.18%	0.00%	95%	100%	0.04%	0.11%	-0.45%	98%	100%
Class F	0.00%	0.00%	0.00%	99%	100%	0.02%	0.07%	0.34%	92%	100%	-0.12%	0.41%	-0.13%	94%	105%

Note : This modification is not included in CE6-3.3 and the other test results.

Conclusions

- CE6-3.3 proposes the following two restrictions.
 - NSST is used only when DCT2 is used as primary transform.
 - DST7 is selected as AMT when width or height is less than or equal to 4.
- It provides 78% EncT with 0.26% loss for RA, and 60% EncT with 0.59% loss for AI.
 - ➡ Useful complexity reduction method in current design, but should be reconsidered after AMT & NSST becomes mature.
- Additional information reports about “EMTFast” and a suggestion for modification.
- This modification provides 92% EncT with 0.05% loss for RA.
 - ➡ It is proposed to adopt this modification into the test model.

Thank KDDI for cross-checking of CE6-3.3 proposal.