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JVET-K0239
CE2-related: Filter size reduction in CTB-based ALF

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Overall Summary

- Based on CE2.4.2.2, propose 9x7cross+3x3square filter shape to reduce two line buffers
- Compared with VTM-1.0 and BMS-1.0

		Over VTM-1.0			Over BMS-1.0 without ALF		
		Y BD-rate	Enc. Time	Dec. Time	Y BD-rate	Enc. Time	Dec. Time
9x7cross+3x3square filter	AI	-2.63%	101%	130%	-2.12%	100%	123%
	RA	-4.78%	100%	139%	-4.52%	100%	125%
	LB	-4.45%	101%	130%	-4.16%	100%	123%

- Compared with 9x9cross+3x3square CTB-based ALF

		Over VTM-1.0 CTB-based ALF with 9x9cross+3x3square filter			Over BMS-1.0 CTB-based ALF with 9x9cross+3x3square filter		
		Y BD-rate	Enc. Time	Dec. Time	Y BD-rate	Enc. Time	Dec. Time
9x7cross+3x3square filter	AI	0.06%	99%	98%	0.05%	100%	100%
	RA	0.04%	99%	96%	0.05%	99%	99%
	LB	0.08%	100%	96%	0.08%	100%	98%

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Introduction

- In the CTB-based ALF, there is only one filter shape
  - 9x9cross+3x3square with half symmetry or full symmetry.

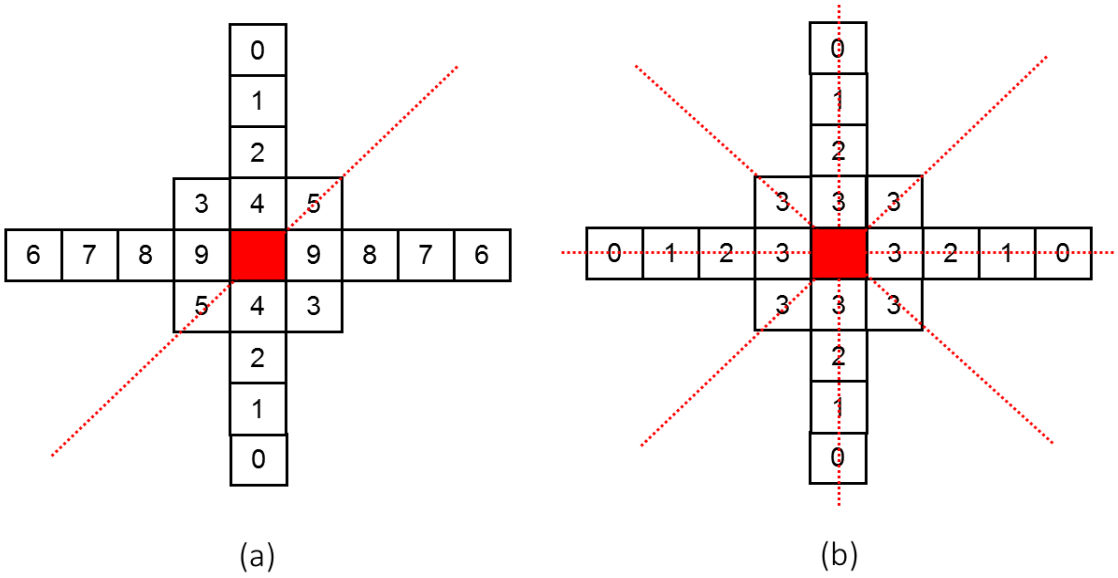

Figure 1. The filter shape in ALF with two coefficient symmetry characteristics. (a) 9x9cross+3x3square with half symmetry, 11 coefficients. (b) 9x9cross+3x3square with full symmetry, 5 coefficients.

Proposed Method

- A 9x7cross+3x3square ALF with half symmetry or full symmetry is proposed to reduce line buffers.

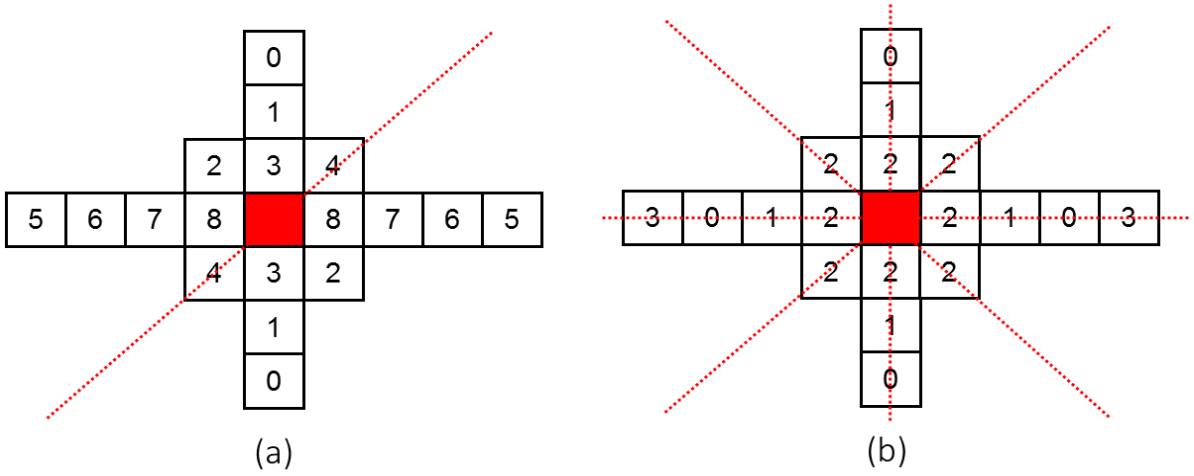

Figure 2. The filter shape in ALF with two coefficient symmetry characteristics. (a) 9x7cross+3x3square with half symmetry, 10 coefficients. (b) 9x7cross+3x3square with full symmetry, 5 coefficients

Proposed Method

- To support GeometricBA, 9x7cross+3x3square ALF can be rotated in four directions

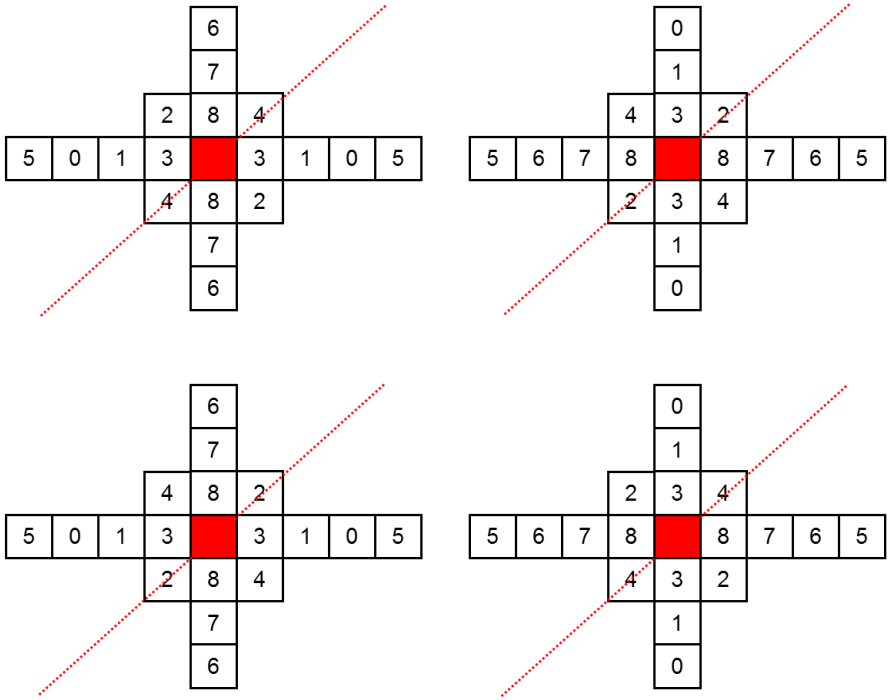

Figure 3. The 9x7cross+3x3square ALF rotated in four directions.

Simulation Results

Table 2. 9x7cross+3x3square CTB-based ALF with IntensitySA and GeometricBA versus 9x9cross+3x3square CTB-based ALF with IntensitySA and GeometricBA.

	All Intra Main10									
	Over VTM-1.0					Over BMS-1.0				
	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
Class A1	0.10%	0.08%	0.05%	99%	98%	0.10%	0.08%	0.08%	100%	101%
Class A2	0.09%	0.00%	0.00%	99%	99%	0.10%	0.01%	-0.01%	100%	99%
Class B	0.04%	-0.03%	-0.05%	99%	98%	0.03%	-0.01%	-0.01%	100%	101%
Class C	0.05%	0.02%	-0.01%	100%	98%	0.03%	0.05%	0.03%	100%	99%
Class E	0.04%	-0.01%	-0.03%	99%	98%	0.03%	-0.02%	-0.02%	100%	100%
Overall	0.06%	0.01%	-0.01%	99%	98%	0.05%	0.02%	0.01%	100%	100%
Class D	0.06%	0.02%	0.02%	99%	98%	0.05%	0.06%	0.01%	99%	99%
Class F (optional)	0.00%	-0.01%	-0.06%	99%	98%	0.00%	0.04%	0.00%	100%	99%

	Random Access Main 10									
	Over VTM-1.0					Over BMS-1.0				
	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
Class A1	0.09%	0.12%	0.11%	99%	93%	0.10%	0.06%	0.22%	99%	98%
Class A2	0.04%	0.01%	0.12%	99%	95%	0.08%	0.13%	0.06%	99%	99%
Class B	0.05%	0.03%	0.06%	99%	97%	0.03%	-0.04%	-0.05%	99%	98%
Class C	0.00%	0.03%	-0.04%	100%	98%	0.01%	0.11%	0.01%	99%	99%
Class E										
Overall	0.04%	0.05%	0.06%	99%	96%	0.05%	0.05%	0.04%	99%	99%
Class D	0.15%	-0.16%	0.24%	100%	100%	0.09%	0.11%	0.00%	100%	100%
Class F (optional)	-0.01%	-0.05%	-0.03%	99%	100%	-0.01%	0.04%	0.05%	99%	100%

	Low delay B Main10									
	Over VTM-1.0					Over BMS-1.0				
	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
Class A1										
Class A2										
Class B	0.09%	0.14%	-0.13%	100%	97%	0.12%	0.06%	-0.11%	99%	97%
Class C	0.15%	-0.14%	0.13%	100%	96%	0.15%	-0.04%	0.07%	100%	98%
Class E	-0.04%	-0.05%	0.10%	100%	97%	-0.06%	-0.16%	-0.31%	100%	99%
Overall	0.08%	0.00%	0.01%	100%	96%	0.08%	-0.03%	-0.10%	100%	98%
Class D	0.17%	-0.16%	-0.15%	100%	95%	0.30%	-0.39%	-0.01%	100%	96%
Class F (optional)	0.08%	0.08%	-0.40%	99%	96%	-0.05%	-0.46%	-0.24%	100%	98%

Conclusions

- Propose 9x7cross+3x3square filter shape instead of 9x9Cross+3x3Square in CE2.4.2.2: CTB-based ALF with slice filter set
  - Two line buffers can be saved
- Experimental results
  - VTM-1.0: less than 0.1% BD-rate increase with 3% decoding time reduction
  - BMS-1.0: less than 0.1% BD-rate increase with 1% decoding time reduction
- Thank HiSilicon for cross-checking the results.

Thank You

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Simulation Results

Table 1. 9x7cross+3x3square CTB-based ALF with IntensitySA and GeometricBA versus ALF off.

	All Intra Main10									
	Over VTM-1.0					Over BMS-1.0				
	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
Class A1	-2.04%	-4.82%	-5.70%	101%	140%	-1.78%	-5.84%	-6.64%	100%	128%
Class A2	-2.70%	-4.87%	-4.64%	101%	133%	-2.48%	-4.38%	-4.29%	100%	126%
Class B	-2.33%	-3.33%	-4.23%	101%	127%	-1.84%	-3.42%	-4.31%	100%	121%
Class C	-2.41%	-3.99%	-5.02%	100%	120%	-1.78%	-3.87%	-4.50%	100%	116%
Class E	-3.96%	-9.04%	-10.13%	101%	137%	-3.01%	-8.48%	-9.41%	100%	131%
Overall	-2.63%	-4.93%	-5.70%	101%	130%	-2.12%	-4.93%	-5.59%	100%	123%
Class D	-1.80%	-3.04%	-3.56%	101%	117%	-1.15%	-2.81%	-3.28%	100%	114%
Class F (optional)	-2.15%	-2.35%	-2.54%	101%	117%	-1.84%	-2.55%	-2.48%	99%	114%

	Random Access Main 10									
	Over VTM-1.0					Over BMS-1.0				
	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
Class A1	-3.81%	-4.15%	-4.47%	99%	150%	-3.52%	-4.31%	-4.04%	100%	135%
Class A2	-6.08%	-3.30%	-5.08%	100%	150%	-6.03%	-2.89%	-5.57%	100%	130%
Class B	-5.41%	-6.99%	-5.16%	100%	134%	-5.06%	-7.36%	-5.60%	100%	123%
Class C	-3.74%	-5.18%	-5.26%	101%	128%	-3.47%	-5.41%	-5.04%	100%	118%
Class E										
Overall	-4.78%	-5.20%	-5.03%	100%	139%	-4.52%	-5.34%	-5.13%	100%	125%
Class D	-4.96%	-3.92%	-4.52%	101%	127%	-4.84%	-3.83%	-4.71%	100%	116%
Class F (optional)	-2.32%	-2.76%	-2.57%	102%	119%	-2.15%	-3.09%	-2.67%	101%	113%

	Low delay B Main10									
	Over VTM-1.0					Over BMS-1.0				
	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
Class A1										
Class A2										
Class B	-4.50%	-7.81%	-7.16%	100%	134%	-4.29%	-7.71%	-7.31%	99%	125%
Class C	-4.00%	-7.42%	-7.06%	100%	126%	-3.92%	-7.72%	-7.33%	100%	122%
Class E	-4.95%	-7.10%	-6.44%	103%	127%	-4.25%	-6.54%	-5.31%	101%	122%
Overall	-4.45%	-7.50%	-6.95%	101%	130%	-4.16%	-7.42%	-6.81%	100%	123%
Class D	-3.67%	-4.42%	-6.35%	101%	124%	-3.84%	-4.70%	-6.42%	100%	120%
Class F (optional)	-5.06%	-6.22%	-5.55%	102%	121%	-4.72%	-6.32%	-5.60%	101%	120%