

JVET-N0218

CE3-related: Chroma Intra Mode Coding with Lumped Luma Directions and Replacement for DM Mode

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Introduction

- Chroma Intra prediction: Planar, DC, Vertical, Horizontal, DM, and CCLM (+ its variants) modes
- DM mode indicates that chroma block has the same intra prediction direction as luma block.
- The luma block: 93 different prediction modes as seen in Fig. 1

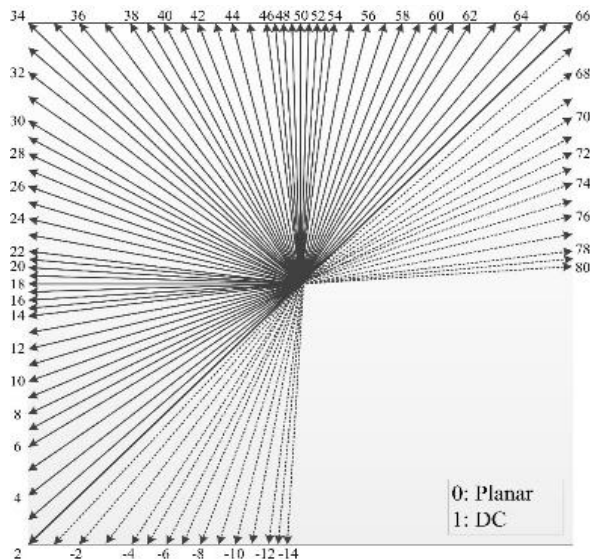


Fig 1 Intra prediction directions

Table 1. Specification of IntraPredModeC[xCb][yCb] in VVC 4.0⁺

(Table 8-2) – Specification of IntraPredModeC[xCb][yCb] depending on intra_chroma_pred_mode[xCb][yCb] and IntraPredModeY[xCb + cbWidth / 2][yCb + cbHeight / 2] when sps_cclm_enabled_flag is equal to 0⁺

intra_chroma_pred_mode[xCb][yCb]	IntraPredModeY[xCb + cbWidth / 2][yCb + cbHeight / 2]				
	0 ⁺	50 ⁺	18 ⁺	1 ⁺	X (0 ≤ X ≤ 66) ⁺
0 ⁺	66 ⁺	0 ⁺	0 ⁺	0 ⁺	0 ⁺
1 ⁺	50 ⁺	66 ⁺	50 ⁺	50 ⁺	50 ⁺
2 ⁺	18 ⁺	18 ⁺	66 ⁺	18 ⁺	18 ⁺
3 ⁺	1 ⁺	1 ⁺	1 ⁺	66 ⁺	1 ⁺
4 ⁺	0 ⁺	50 ⁺	18 ⁺	1 ⁺	X ⁺

(Table 8-3) – Specification of IntraPredModeC[xCb][yCb] depending on intra_chroma_pred_mode[xCb][yCb] and IntraPredModeY[xCb + cbWidth / 2][yCb + cbHeight / 2] when sps_cclm_enabled_flag is equal to 1⁺

intra_chroma_pred_mode[xCb][yCb]	IntraPredModeY[xCb + cbWidth / 2][yCb + cbHeight / 2]				
	0 ⁺	50 ⁺	18 ⁺	1 ⁺	X (0 ≤ X ≤ 66) ⁺
0 ⁺	66 ⁺	0 ⁺	0 ⁺	0 ⁺	0 ⁺
1 ⁺	50 ⁺	66 ⁺	50 ⁺	50 ⁺	50 ⁺
2 ⁺	18 ⁺	18 ⁺	66 ⁺	18 ⁺	18 ⁺
3 ⁺	1 ⁺	1 ⁺	1 ⁺	66 ⁺	1 ⁺
4 ⁺	81 ⁺	81 ⁺	81 ⁺	81 ⁺	81 ⁺
5 ⁺	82 ⁺	82 ⁺	82 ⁺	82 ⁺	82 ⁺
6 ⁺	83 ⁺	83 ⁺	83 ⁺	83 ⁺	83 ⁺
7 ⁺	0 ⁺	50 ⁺	18 ⁺	1 ⁺	X ⁺

Table 1 Specification of IntraPredModeC[xCb][yCb] in VVC 4.0

Proposed Modification 1

- Proposal 1:** for horizontally rectangular chroma block, the current replacement of luma direction by VDIA (mode 66) is changed to DIA (mode 2)

```

if(chroma.width > chroma.height)
    Use Table 2 // Modified (use DIA(#2))
else
    Use Table 1 // As in VVC4.0 (use VDIA(#66))
    
```

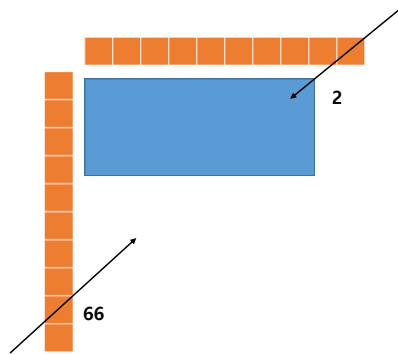


Fig. 2. Horizontally rectangular chroma block

(Table 8-2) – Specification of IntraPredModeC[xCb][yCb] depending on intra_chroma_pred_mode[xCb][yCb] and IntraPredModeY[xCb + cbWidth / 2][yCb + cbHeight / 2] when sps_cclm_enabled_flag is equal to 0

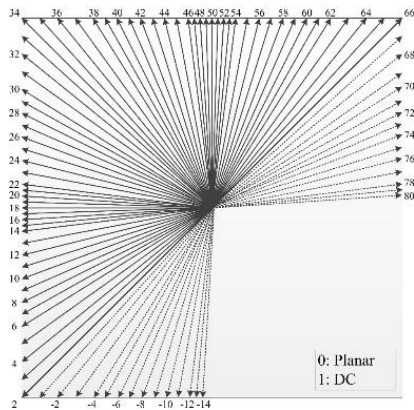
intra_chroma_pred_mode[xCb][yCb]	IntraPredModeY[xCb + cbWidth / 2][yCb + cbHeight / 2]				
	0	50	18	1	X (0 ≤ X ≤ 66)
0	2	0	0	0	0
1	50	2	50	50	50
2	18	18	2	18	18
3	1	1	1	2	1
4	0	50	18	1	X

(Table 8-3) – Specification of IntraPredModeC[xCb][yCb] depending on intra_chroma_pred_mode[xCb][yCb] and IntraPredModeY[xCb + cbWidth / 2][yCb + cbHeight / 2] when sps_cclm_enabled_flag is equal to 1

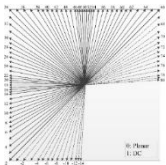
intra_chroma_pred_mode[xCb][yCb]	IntraPredModeY[xCb + cbWidth / 2][yCb + cbHeight / 2]				
	0	50	18	1	X (0 ≤ X ≤ 66)
0	2	0	0	0	0
1	50	2	50	50	50
2	18	18	2	18	18
3	1	1	1	2	1
4	81	81	81	81	81
5	82	82	82	82	82
6	83	83	83	83	83
7	0	50	18	1	X

Proposed Modification 2

- **Proposal 2:** for small chroma blocks, some luma intra prediction directions are lumped for DM mode decision purpose
 - treat 2 neighboring luma intra prediction directions to Horiz. (or, Vert.) as Horizontal (or, Vertical) for DM mode decision purpose
 - Involve simple change in the table!



Chroma Block



Chroma Block

(Table 8-2) – Specification of IntraPredModeC[xCb][yCb] depending on intra_chroma_pred_mode[xCb][yCb] and IntraPredModeY[xCb + cbWidth / 2][yCb + cbHeight / 2] when sps_cclm_enabled_flag is equal to 0

intra_chroma_pred_mode[xCb][yCb]	IntraPredModeY[xCb + cbWidth / 2][yCb + cbHeight / 2]				
	0	49,50,51	17,18,19	1	X (0 <= X <= 66)
0	66	0	0	0	0
1	50	66	50	50	50
2	18	18	66	18	18
3	1	1	1	66	1
4	0	50	18	1	X

(Table 8-3) – Specification of IntraPredModeC[xCb][yCb] depending on intra_chroma_pred_mode[xCb][yCb] and IntraPredModeY[xCb + cbWidth / 2][yCb + cbHeight / 2] when sps_cclm_enabled_flag is equal to 1

intra_chroma_pred_mode[xCb][yCb]	IntraPredModeY[xCb + cbWidth / 2][yCb + cbHeight / 2]				
	0	49,50,51	17,18,19	1	X (0 <= X <= 66)
0	66	0	0	0	0
1	50	66	50	50	50
2	18	18	66	18	18
3	1	1	1	66	1
4	81	81	81	81	81
5	82	82	82	82	82
6	83	83	83	83	83
7	0	50	18	1	X

Fig 2 Intra prediction directions

Experiment result(1)

- Test 1: VTM4.0 + Proposal 1 with Anchor: VTM4.0
 - Replacement Direction for DM mode

All Intra Main10					
Over VTM-4.0					
	Y	U	V	EncT	DecT
Class A1	0.00%	-0.01%	-0.03%	100%	100%
Class A2	-0.01%	0.09%	-0.04%	100%	100%
Class B	-0.01%	-0.02%	0.02%	100%	100%
Class C	0.01%	-0.03%	-0.06%	100%	100%
Class E	-0.02%	0.01%	-0.05%	100%	100%
Overall	-0.01%	0.00%	-0.03%	100%	100%
Class D	-0.02%	-0.08%	-0.12%	100%	100%
Class F	0.37%	0.32%	0.32%	100%	100%

Random access Main10					
Over VTM-4.0					
	Y	U	V	EncT	DecT
Class A1	0.02%	-0.03%	-0.01%	100%	100%
Class A2	-0.03%	-0.06%	0.01%	100%	100%
Class B	-0.01%	0.02%	-0.04%	100%	100%
Class C	0.03%	-0.09%	-0.06%	101%	100%
Class E					
Overall	0.00%	-0.04%	-0.03%	100%	100%
Class D	-0.03%	-0.14%	0.01%	100%	100%
Class F	-0.02%	-0.08%	0.00%	101%	100%

Experiment result(2)

- Test 2: VTM-4.0+Proposal 2 with Anchor (VTM4.0)
 - Lump luma intra pred. direction for $\leq 4 \times 4$

	All Intra Main10				
	Over VTM-4.0			EncT	DecT
	Y	U	V		
Class A1	0.00%	0.01%	0.01%	100%	100%
Class A2	-0.01%	0.06%	-0.03%	100%	100%
Class B	0.00%	0.00%	-0.02%	100%	100%
Class C	-0.24%	-0.29%	-0.24%	100%	100%
Class E	0.00%	0.00%	-0.01%	100%	100%
Overall	-0.05%	-0.05%	-0.06%	100%	100%
Class D	-0.46%	-0.47%	-0.68%	100%	100%
Class F	0.00%	-0.04%	-0.01%	100%	100%

	Random access Main10				
	Over VTM-4.0			EncT	DecT
	Y	U	V		
Class A1	#VALUE!	#VALUE!	#VALUE!	#NUM!	#NUM!
Class A2	#VALUE!	#VALUE!	#VALUE!	#NUM!	#NUM!
Class B	#VALUE!	#VALUE!	#VALUE!	#NUM!	#NUM!
Class C	0.34%	-0.41%	-0.40%	100%	100%
Class E					
Overall	#VALUE!	#VALUE!	#VALUE!	#NUM!	#NUM!
Class D	-0.01%	-0.07%	-0.10%	100%	100%
Class F	-0.02%	-0.04%	-0.11%	100%	100%

Experiment result(3)

- Test 2: VTM-4.0+Proposal 2 with Anchor (VTM4.0)
 - Lump luma intra pred. direction for $\leq 16 \times 16$

All Intra Main10					
Over VTM-4.0					
	Y	U	V	EncT	DecT
Class A1	0.00%	-0.05%	0.04%	100%	100%
Class A2	-0.01%	0.12%	-0.01%	100%	100%
Class B	0.00%	0.00%	0.00%	100%	100%
Class C	0.01%	-0.04%	0.02%	100%	100%
Class E	0.00%	0.01%	-0.04%	100%	100%
Overall	0.00%	0.01%	0.00%	100%	100%
Class D	-0.01%	0.02%	-0.01%	100%	100%
Class F	-0.01%	-0.04%	-0.05%	100%	100%

Random access Main10					
Over VTM-4.0					
	Y	U	V	EncT	DecT
Class A1	0.00%	-0.01%	0.02%	100%	100%
Class A2	-0.03%	0.11%	0.05%	100%	100%
Class B	0.00%	-0.02%	-0.07%	100%	100%
Class C	0.01%	0.08%	-0.09%	101%	100%
Class E					
Overall	0.00%	0.03%	-0.03%	100%	100%
Class D	0.00%	-0.17%	-0.12%	100%	100%
Class F	-0.02%	0.03%	-0.09%	101%	100%

Experiment result(4)

- Test 3: Proposals 1 and 2 with Anchor (VTM4.0)
 - Replacement Direction for DM mode
 - Lump luma intra pred. direction for $\leq 16 \times 16$

All Intra Main10					
Over VTM-4.0					
	Y	U	V	EncT	DecT
Class A1	0.00%	0.05%	-0.04%	100%	100%
Class A2	-0.02%	0.13%	-0.01%	100%	100%
Class B	-0.01%	-0.02%	0.11%	100%	100%
Class C	0.00%	-0.04%	0.06%	100%	100%
Class E	-0.01%	0.11%	0.05%	100%	100%
Overall	-0.01%	0.04%	0.04%	100%	100%
Class D	-0.01%	-0.06%	-0.15%	100%	100%
Class F	0.01%	-0.02%	0.09%	100%	100%

Random access Main10					
Over VTM-4.0					
	Y	U	V	EncT	DecT
Class A1	0.01%	0.09%	0.02%	100%	100%
Class A2	0.00%	0.02%	-0.02%	100%	100%
Class B	-0.02%	-0.13%	-0.15%	100%	100%
Class C	0.02%	-0.15%	-0.24%	100%	100%
Class E					
Overall	0.00%	-0.06%	-0.11%	100%	100%
Class D	0.00%	0.01%	-0.21%	100%	100%
Class F	-0.01%	0.00%	0.02%	100%	100%

Summary

- **Proposal 1 (Replacement for DM mode)**
 - Al: -0.01% (Y), 0.00% (Cb), and -0.03% (Cr)
 - RA: 0.00% (Y), -0.04% (Cb), and -0.03%(Cr)
- **Proposal 2 (Lumping of Hor and Vert Luma mode)**
 - **Lumping for $\leq 4 \times 4$**
 - Al: -0.05% (Y), -0.05% (Cb), and -0.06% (Cr)
 - RA: % (Y), % (Cb), and %(Cr)
 - **Lumping for $\leq 16 \times 16$**
 - Al: 0.00% (Y), 0.01% (Cb), and 0.03% (Cr)
 - RA: 0.00 % (Y), 0.03 % (Cb), and -0.03%(Cr)
- **Proposal 3 (Proposal 1 + Proposal 2 (with $\leq 16 \times 16$))**
 - Al: -0.01% (Y), 0.04% (Cb), and 0.04% (Cr)
 - RA: 0.00% (Y), -0.08% (Cb), and -0.11%(Cr)
- It is proposed to test the proposed methods further in CE test.

Note: Thanks to Cross-Check by Samsung