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JVET-O0276

CE3-related: Simplifications for MIP

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Overall Summary

- Three simplifications are proposed to simplify the Matrix-based Intra Prediction mode (MIP)
  - Simplification 1: reuse the reference samples derivation of non-MIP intra prediction mode
  - Simplification 2: remove the two-stage downsampling on reference samples
  - Simplification 3: reduce the worst case number of clipping from 64x64 to 8x8

BD-rates	AI			RA			LB		
	Y	Cb	Cr	Y	Cb	Cr	Y	Cb	Cr
Simplifications 1+2+3	-0.01%	-0.08%	-0.02%	0.00%	-0.09%	-0.12%	0.03%	0.17%	0.22%

Introduction to MIP

- The reference sample derivation is different from non-MIP mode
- A two-stage downsampling is applied to generate the intermediate data for upsampling and matrix multiplocation
  - Block_size → upSampling_size →matrix_mult_size

stage-1 stage-2

- The worst case number of clipping in one block is 64x64
  - Clippings are applied after upsampling

Simplification 1

- Reuse the reference samples derivation of non-MIP intra prediction mode
  - Reference samples are checked from bottom-left to top-right
  - Reference samples are not filtered in MIP blocks

Simplification 2

- Remove the two-stage downsampling on reference samples in matrix vector multiplication
  - Reference samples for upsampling are the original reference samples
    - uDwn = nTbS / upsBdrySize
    - upsBdryS[x] = refS[(x+1)*uDwn-1]
  - Reference samples for matrix vector multiplication are derived using one-stage downsampling

Simplification 3

- Reduce the worst case number of clipping from 64x64 to 8x8
  - Clip the prediction samples into 10-bit before upsampling

Results - Simplifications 1 + 2 + 3

	All Intra Main10				
	Over VTM-5.0				
	Y	U	V	EncT	DecT
Class A1	-0.03%	-0.09%	-0.01%	101%	100%
Class A2	-0.02%	-0.06%	-0.08%	101%	102%
Class B	-0.02%	-0.13%	0.00%	101%	99%
Class C	0.03%	-0.07%	0.03%	101%	100%
Class E	-0.01%	-0.02%	-0.07%	101%	101%
Overall	**-0.01%**	**-0.08%**	**-0.02%**	**101%**	**100%**
Class D	0.02%	0.23%	0.01%	100%	100%
Class F	0.01%	0.04%	0.05%	101%	103%

	Random access Main10				
	Over VTM-5.0				
	Y	U	V	EncT	DecT
Class A1	-0.01%	-0.19%	0.01%	100%	97%
Class A2	0.04%	-0.03%	0.04%	101%	102%
Class B	0.00%	-0.09%	-0.29%	100%	100%
Class C	-0.01%	-0.06%	-0.14%	100%	97%
Class E					
Overall	**0.00%**	**-0.09%**	**-0.12%**	**100%**	**99%**
Class D	-0.01%	0.25%	0.70%	100%	99%
Class F	0.00%	-0.07%	-0.02%	101%	97%

	Low delay B Main10				
	Over VTM-5.0				
	Y	U	V	EncT	DecT
Class A1					
Class A2					
Class B	-0.02%	0.27%	0.22%	101%	99%
Class C	0.03%	0.04%	-0.05%	100%	100%
Class E	0.12%	0.17%	0.58%	100%	98%
Overall	**0.03%**	**0.17%**	**0.22%**	**100%**	**99%**
Class D	0.00%	-0.09%	0.60%	98%	99%
Class F	0.00%	-0.06%	-0.56%	98%	98%

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Conclusion

- Simplification 1: align the reference samples derivation in MIP mode to that in non-MIP intra prediction mode
- Simplification 2: remove 2-stage downsampling on reference samples
- Simplification 3: reduce the worst case number of clippings from 64x64 to 64
- Thank Huawei for cross-checking!

BD-rates (%)	AI			RA			LB		
	Y	Cb	Cr	Y	Cb	Cr	Y	Cb	Cr
Simplification 1	0.00	-0.04	-0.02	0.00	-0.10	-0.03	0.00	0.00	0.06
Simplification 2	-0.01	-0.09	0.00	-0.01	-0.07	-0.16	0.04	-0.17	0.19
Simplification 3	0.00	0.01	0.00	0.00	-0.05	0.01	-0.03	-0.10	0.17
Combined	-0.01	-0.08	-0.02	0.00	-0.09	-0.12	0.03	0.17	0.22

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Thank you!

Backup

Results - Simplification 1

	All Intra Main10				
	Over VTM-5.0				
	Y	U	V	EncT	DecT
Class A1	-0.01%	-0.03%	-0.02%	100%	100%
Class A2	0.00%	-0.03%	-0.04%	101%	103%
Class B	0.00%	-0.06%	-0.01%	100%	100%
Class C	0.01%	-0.02%	0.01%	100%	99%
Class E	0.01%	-0.06%	-0.03%	100%	102%
Overall	**0.00%**	**-0.04%**	**-0.02%**	**100%**	**101%**
Class D	0.01%	0.31%	-0.01%	102%	103%
Class F	-0.02%	-0.01%	-0.01%	101%	104%

	Random access Main10				
	Over VTM-5.0				
	Y	U	V	EncT	DecT
Class A1	0.01%	-0.21%	0.15%	100%	98%
Class A2	0.03%	-0.02%	0.03%	100%	99%
Class B	0.01%	0.01%	-0.03%	100%	97%
Class C	-0.05%	-0.20%	-0.20%	100%	97%
Class E					
Overall	**0.00%**	**-0.10%**	**-0.03%**	**100%**	**98%**
Class D	0.04%	0.08%	0.26%	99%	99%
Class F	0.02%	-0.04%	0.02%	100%	97%

	Low delay B Main10				
	Over VTM-5.0				
	Y	U	V	EncT	DecT
Class A1					
Class A2					
Class B	0.00%	0.11%	-0.15%	100%	99%
Class C	0.05%	0.04%	-0.07%	100%	103%
Class E	-0.04%	-0.26%	0.58%	100%	98%
Overall	**0.00%**	**0.00%**	**0.06%**	**100%**	**100%**
Class D	0.01%	-0.47%	0.05%	98%	99%
Class F	0.00%	0.43%	0.12%	98%	98%

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Results - Simplification 2

	All Intra Main10				
	Over VTM-5.0				
	Y	U	V	EncT	DecT
Class A1	-0.04%	-0.11%	-0.07%	100%	99%
Class A2	-0.01%	-0.09%	-0.11%	100%	100%
Class B	-0.02%	-0.08%	0.03%	100%	101%
Class C	0.00%	-0.08%	0.10%	100%	99%
Class E	-0.01%	-0.07%	-0.03%	100%	100%
Overall	**-0.01%**	**-0.09%**	**0.00%**	**100%**	**100%**
Class D	0.01%	0.12%	-0.20%	100%	100%
Class F	0.00%	0.05%	0.04%	101%	104%

	Random access Main10				
	Over VTM-5.0				
	Y	U	V	EncT	DecT
Class A1	-0.01%	-0.24%	0.01%	100%	100%
Class A2	0.00%	0.07%	0.04%	100%	102%
Class B	-0.01%	-0.04%	-0.27%	99%	97%
Class C	0.00%	-0.08%	-0.30%	99%	98%
Class E					
Overall	**-0.01%**	**-0.07%**	**-0.16%**	**100%**	**99%**
Class D	-0.01%	0.09%	0.27%	99%	100%
Class F	0.03%	-0.04%	0.18%	99%	97%

	Low delay B Main10				
	Over VTM-5.0				
	Y	U	V	EncT	DecT
Class A1					
Class A2					
Class B	0.01%	0.22%	-0.07%	100%	99%
Class C	0.07%	0.11%	0.18%	100%	100%
Class E	0.06%	-1.18%	0.66%	100%	98%
Overall	**0.04%**	**-0.17%**	**0.19%**	**100%**	**99%**
Class D	-0.01%	-0.96%	0.22%	97%	99%
Class F	-0.01%	0.00%	-0.67%	97%	97%

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Results - Simplification 3

	All Intra Main10				
	Over VTM-5.0				
	Y	U	V	EncT	DecT
Class A1	0.00%	0.03%	-0.02%	100%	102%
Class A2	0.00%	-0.01%	0.00%	100%	101%
Class B	0.00%	0.02%	0.03%	100%	101%
Class C	0.00%	0.02%	-0.04%	100%	99%
Class E	0.00%	0.01%	0.04%	101%	101%
Overall	**0.00%**	**0.01%**	**0.00%**	**100%**	**101%**
Class D	0.00%	0.02%	-0.01%	101%	103%
Class F	0.01%	-0.05%	0.05%	101%	100%

	Random access Main10				
	Over VTM-5.0				
	Y	U	V	EncT	DecT
Class A1	0.00%	-0.09%	-0.02%	101%	99%
Class A2	0.00%	0.02%	0.02%	100%	99%
Class B	0.00%	-0.04%	0.05%	101%	97%
Class C	-0.02%	-0.09%	0.00%	100%	97%
Class E					
Overall	**0.00%**	**-0.05%**	**0.01%**	**101%**	**98%**
Class D	0.01%	0.05%	0.05%	101%	100%
Class F	0.00%	-0.11%	-0.04%	101%	97%

	Low delay B Main10				
	Over VTM-5.0				
	Y	U	V	EncT	DecT
Class A1					
Class A2					
Class B	-0.01%	0.05%	0.59%	100%	99%
Class C	-0.02%	0.04%	-0.11%	100%	100%
Class E	-0.08%	-0.56%	-0.15%	100%	99%
Overall	**-0.03%**	**-0.10%**	**0.17%**	**100%**	**99%**
Class D	0.05%	0.05%	0.27%	98%	99%
Class F	-0.02%	-0.21%	0.70%	98%	97%

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