

# Chroma intra prediction based on residual luma samples

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# Overview

- New intra prediction mode for chroma
  - Based on residual luma samples
    - Similar to chroma\_from\_luma
  - Harmonization with existing modes in HM3.0
    - No replacement for any mode.
  - BD-bitrate -3.4% & -3.9% (U&V, AI/HE)
  - BD-bitrate -3.5% & -3.9% (U&V, AI/LC)
  - Additional complexity is negligible.
- Cross-checked by NTT (JCTVC-F097)

# Introduction

- LM mode (chroma intra prediction) in HM3.0
  - uses reconstructed luma samples
  - $\text{Pred}_C[x, y] = \alpha \cdot \text{Rec}'_L[x, y] + \beta$
  - Parameters  $\alpha$  and  $\beta$  are derived from adjacent blocks
- Only LM mode is insufficient to predict object boundary regions
  - Correlation between luma and chroma is varying

# Motivation & Solution

- Motivation
  - Reduce two redundancy simultaneously
    - Adjacent pixels' correlation and inter-channel correlation
  - Improve inter-channel prediction performance
- Proposed solution: RM mode
  - Inter-channel residual prediction between luma and chroma as an additional mode
  - Chroma is predicted twice.

# Proposed method (RM mode)

- Luma intra prediction in HM3.0 (no change)
- Chroma intra prediction with three steps
  1. Chroma intra prediction with mode 4 (derived from luma) in HM3.0
  2. Chroma intra residual prediction with  $\alpha$  derived on the encoder side

$$\text{ResiPred}_C[x, y] = \alpha \cdot \text{ResiRec}'_L[x, y] + \beta$$

3. Residual samples from above two steps are transformed, quantized and coded.

# Comparison between LM and RM

- Prediction target
  - LM: Base-band samples
  - RM: Intra residual samples
- Parameters in the model
  - LM: Not coded and derived from adjacent blocks
  - RM:  $\alpha$  is derived at the encoder side and coded. Syntax is then changed.
- Above two modes are complementary.

# Experimental Results 1

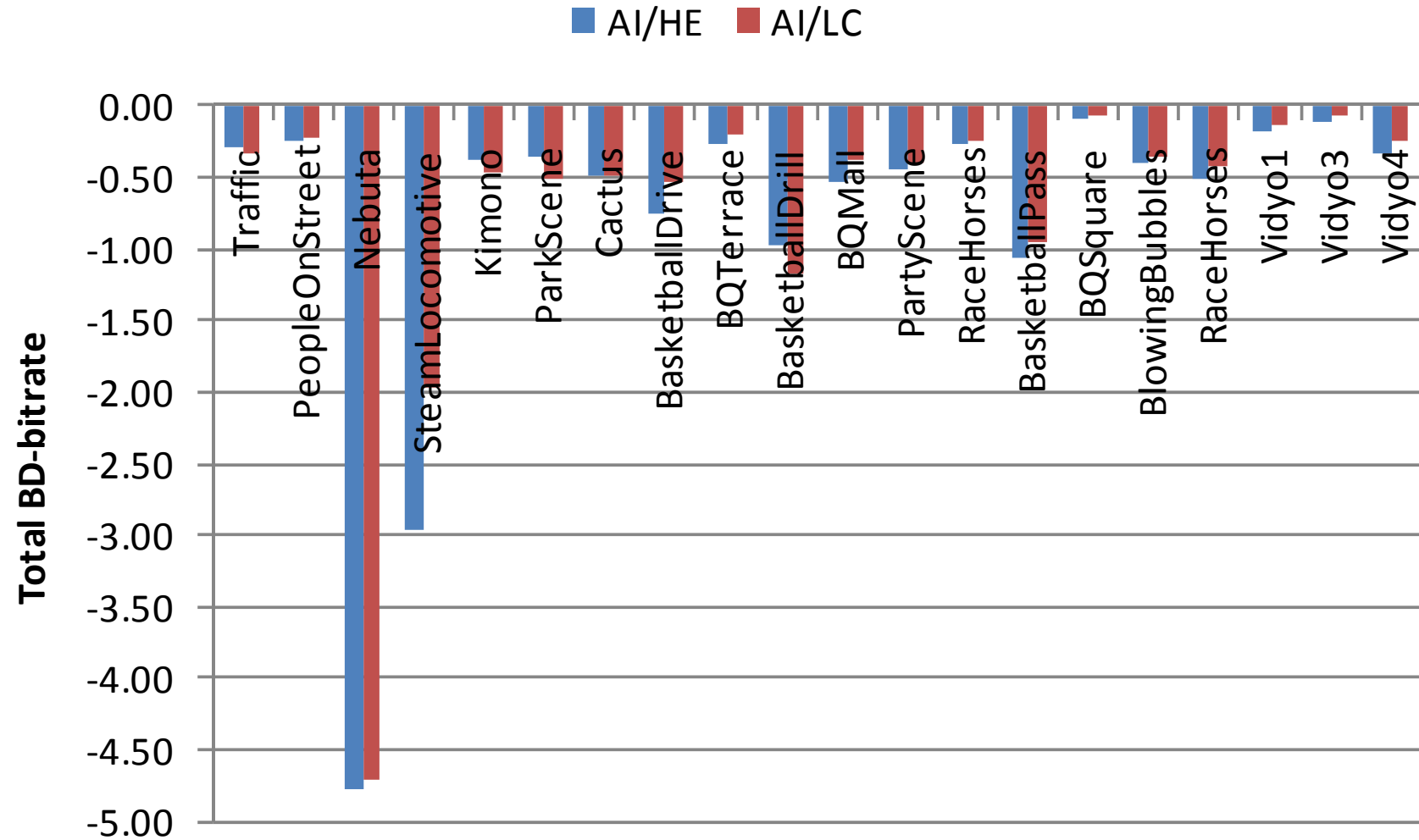
- Implemented on HM3.0
- Summary of the results for all intra

	All intra HE				All intra LC			
	Y BD-rate	U BD-rate	V BD-rate	Total	Y BD-rate	U BD-rate	V BD-rate	Total
Class A	-0.12	-9.90	-12.11	-2.07	-0.14	-10.83	-12.62	-1.81
Class B	-0.01	-2.22	-2.04	-0.45	-0.07	-2.36	-1.86	-0.44
Class C	-0.15	-1.89	-2.21	-0.56	-0.18	-1.82	-2.24	-0.55
Class D	-0.14	-1.91	-2.02	-0.52	-0.14	-1.70	-1.89	-0.46
Class E	-0.06	-0.97	-0.67	-0.21	-0.02	-0.73	-0.87	-0.15
Overall	-0.09	-3.44	-3.88	-0.77	-0.11	-3.57	-3.95	-0.69
Enc Time[%]	106.07%				107.64%			
Dec Time[%]	101.64%				101.77%			

Total BD-bitrate is derived from bit-rate and total PSNR.

Total PSNR is derived from total SSE of all components (Y, U, V)

# Experimental Results 2





# Experimental Results 3

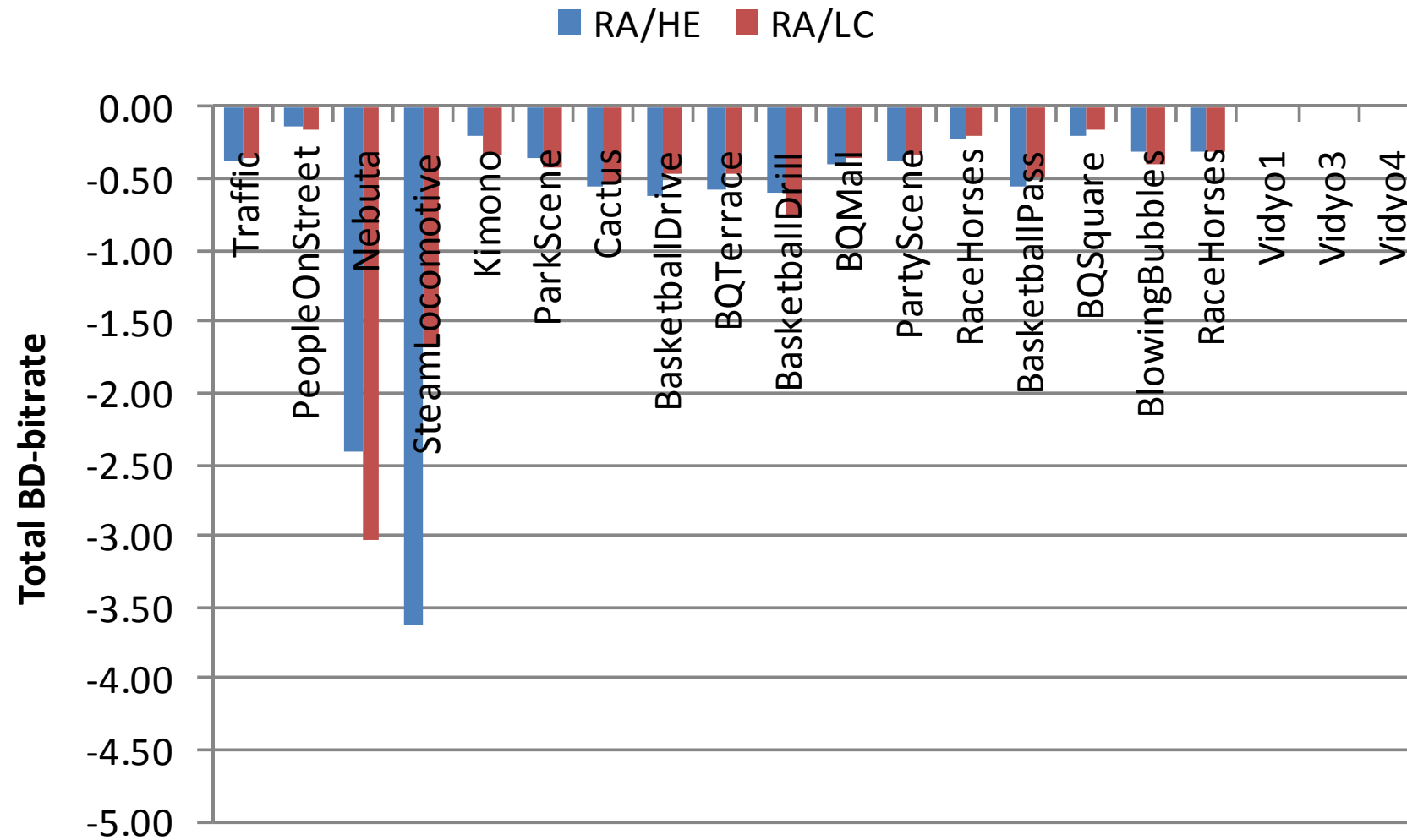
- Implemented on HM3.0
- Summary of the results for random access

	Random access HE				Random access LC			
	Y BD-rate	U BD-rate	V BD-rate	Total	Y BD-rate	U BD-rate	V BD-rate	Total
Class A	0.18	-12.76	-12.38	-1.64	0.08	-13.54	-10.97	-1.31
Class B	0.00	-2.79	-2.11	-0.46	-0.07	-2.81	-1.98	-0.44
Class C	-0.01	-1.90	-2.14	-0.40	-0.06	-1.94	-2.17	-0.41
Class D	-0.01	-1.59	-2.25	-0.34	-0.06	-1.82	-1.92	-0.34
Class E								
Overall	0.04	-4.64	-4.57	-0.70	-0.03	-4.90	-4.13	-0.62
Enc Time[%]	101.55%				101.81%			
Dec Time[%]	100.33%				99.98%			

Total BD-bitrate is derived from bit-rate and total PSNR.

Total PSNR is derived from total SSE of all components (Y, U, V)

# Experimental Results 4



# Conclusion

- New intra prediction mode for chroma
  - Harmonization with existing modes in HM3.0.
  - BD-bitrate -3.4% & -3.9% (U&V, AI/HE)
  - BD-bitrate -3.5% & -3.9% (U&V, AI/LC)
  - Additional complexity is negligible.
  - Further significant gain will be obtained for 4:4:4 contents .
- We propose to adopt the RM mode into the “CE: intra prediction improvement.”