JCTVC-R0165
NON-SCCE1: Improved intra block copy coding with block vector derivation

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invention | collaboration | contribution

Introduction

- Full frame intra block copy(IBC) is studied in SCCE1
  - BV becomes larger with full frame hash based search
  - Overhead for BV information coding increases, and its impact on mode decision also increases
- IBC merge mode with two candidates was investigated in SCCE1 test 2.3
- This proposal presents the BV/MV derivation method using the signaled BV
- Derived BV/MV is used for
  - Enhanced merge candidate list
 - Extended IBC mode

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BV derivation method
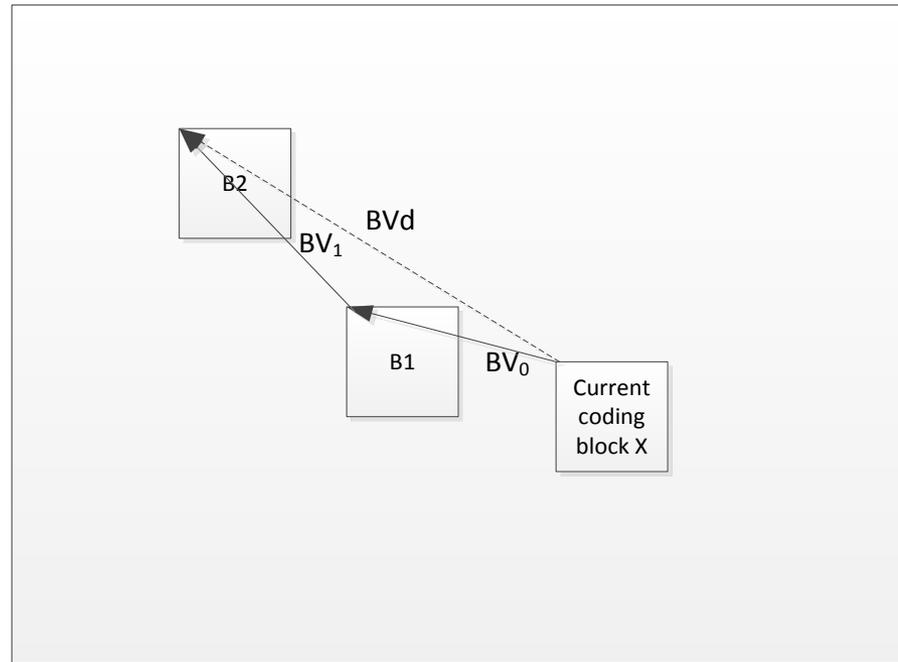
$$BV_d = BV_0 + BV_1$$

- BV_0 is the BV of current block
- The reference block B1 is IBC coded, and its own BV is BV_1

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MV derivation method

Reference picture Rx   Current picture Pc
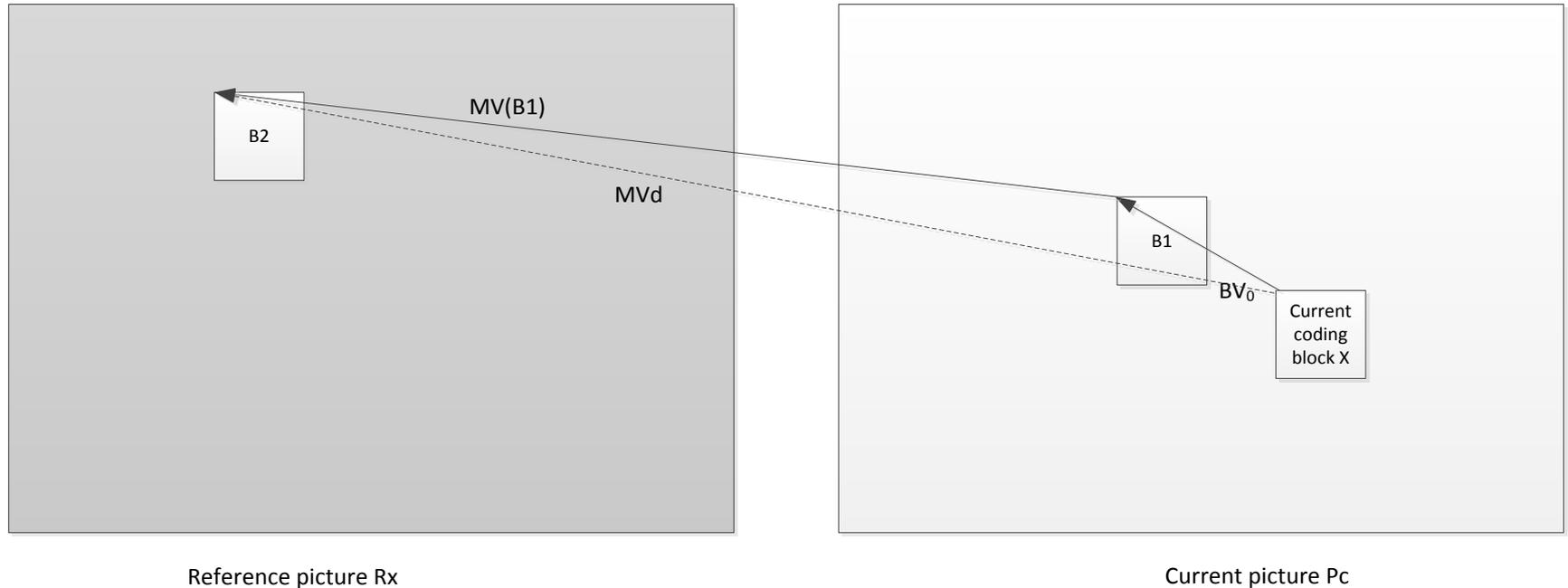
$$MV_d = BV_0 + ((MV(B1)+2) >> 2)$$

- BV_0 is the BV of current block
- The reference block B1 is inter coded, and its own MV is MV(B1)
  - If B1 is bi-prediction inter mode, then MV(B1) is selected as the motion vector associated with the higher quality reference picture (smaller QP)

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IBC merge mode using derived BV

- IBC merge candidate list construction
  - BV predictor (last coded BV);
  - Five spatial BVs from neighboring blocks (C0 to C4), if unique
  - Derived BV from each BV already in the list if unique
- Maximum number of IBC merge candidates is 5

C4	C1		C2
C0			
	Current coding block		
C3			
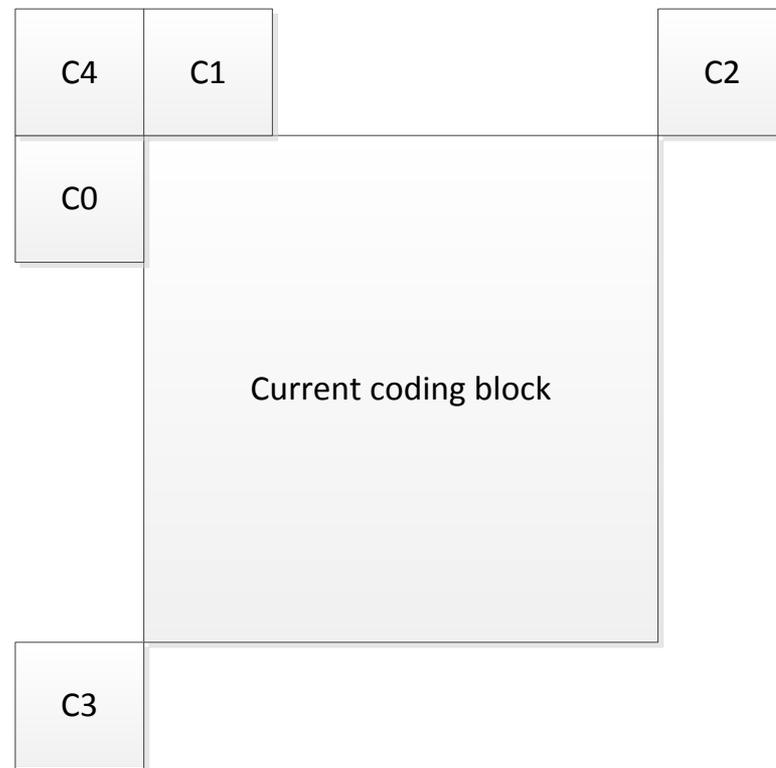
Spatial neighboring blocks

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IBC mode using derived BV/MV

- IBC mode is extended by adding one flag to indicate if BV/MV derivation is applied or not
  - If the flag is 1, BV/MV derivation is applied using the signaled BV
    - ➤ IBC prediction with derived BV is applied if BV is derived
    - ➤ Motion compensated prediction with derived MV in integer pixel precision is applied if MV is derived

  - Otherwise, IBC prediction with signaled BV is applied

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Performance evaluation, three tests with full frame IBC configurations

Test	IntraBC merge with BV derivation	Normal IntraBC with BV/MV derivation
A	√	×
B	×	√
C	√	√

Performance evaluation, lossy coding of Test A

	All Intra			Random Access			Low delay B		
	G/Y	B/U	R/V	G/Y	B/U	R/V	G/Y	B/U	R/V
RGB, text & graphics with motion, 1080p	-9.0%	-9.1%	-9.1%	-5.6%	-5.5%	-5.6%	-4.4%	-4.3%	-4.2%
RGB, text & graphics with motion,720p	-5.5%	-5.7%	-5.7%	-3.5%	-3.7%	-3.7%	-1.4%	-1.3%	-1.5%
RGB, mixed content, 1440p	-3.7%	-3.7%	-3.7%	-2.4%	-2.4%	-2.3%	-1.6%	-1.6%	-1.5%
RGB, mixed content, 1080p	-3.9%	-3.8%	-3.8%	-2.5%	-2.5%	-2.6%	-1.4%	-1.2%	-1.4%
RGB, Animation, 720p	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.1%	0.0%	-0.1%	0.0%
RGB, camera captured, 1080p	0.0%	0.0%	-0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
YUV, text & graphics with motion, 1080p	-9.0%	-9.2%	-9.2%	-5.7%	-5.8%	-5.8%	-4.4%	-4.4%	-4.4%
YUV, text & graphics with motion,720p	-6.1%	-6.3%	-6.4%	-3.9%	-3.9%	-3.8%	-1.3%	-1.0%	-1.5%
YUV, mixed content, 1440p	-3.9%	-4.0%	-4.1%	-2.4%	-2.7%	-2.8%	-1.7%	-1.8%	-1.8%
YUV, mixed content, 1080p	-4.2%	-4.2%	-4.3%	-2.9%	-3.1%	-3.0%	-1.3%	-2.5%	-0.7%
YUV, Animation, 720p	-0.3%	-0.3%	-0.4%	-0.1%	-0.3%	-0.1%	0.0%	-0.2%	-0.1%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.1%	-0.2%
Enc Time[%]	116%			103%			102%		
Dec Time[%]	93%			100%			99%		

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Performance evaluation, lossy coding of Test B

	All Intra			Random Access			Low delay B		
	G/Y	B/U	R/V	G/Y	B/U	R/V	G/Y	B/U	R/V
RGB, text & graphics with motion, 1080p	-2.8%	-2.9%	-3.0%	-1.7%	-1.7%	-1.8%	-1.2%	-1.3%	-1.2%
RGB, text & graphics with motion,720p	-2.2%	-2.3%	-2.3%	-1.5%	-1.5%	-1.5%	-0.9%	-0.6%	-0.6%
RGB, mixed content, 1440p	-1.2%	-1.2%	-1.2%	-0.7%	-0.7%	-0.7%	-0.5%	-0.7%	-0.5%
RGB, mixed content, 1080p	-1.3%	-1.3%	-1.3%	-0.9%	-0.8%	-0.9%	-0.7%	-0.2%	-0.7%
RGB, Animation, 720p	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	0.0%	0.0%	0.0%	0.0%
RGB, camera captured, 1080p	0.0%	0.0%	0.0%	0.0%	0.0%	-0.1%	-0.1%	0.0%	-0.1%
YUV, text & graphics with motion, 1080p	-2.4%	-2.6%	-2.6%	-1.2%	-1.5%	-1.5%	-0.9%	-1.1%	-1.1%
YUV, text & graphics with motion,720p	-2.2%	-2.4%	-2.4%	-1.3%	-1.6%	-1.5%	-0.6%	-0.6%	-0.9%
YUV, mixed content, 1440p	-1.1%	-1.2%	-1.2%	-0.6%	-0.9%	-0.7%	-0.3%	-0.7%	-0.4%
YUV, mixed content, 1080p	-1.2%	-1.3%	-1.2%	-0.9%	-1.0%	-0.9%	0.0%	-0.5%	0.2%
YUV, Animation, 720p	-0.1%	-0.1%	-0.1%	0.0%	-0.3%	0.0%	-0.1%	-0.5%	-0.5%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%	0.0%	-0.1%	0.0%	0.0%	-0.1%	-0.2%
Enc Time[%]		114%			102%			101%	
Dec Time[%]		98%			100%			101%	

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Performance evaluation, lossy coding of Test C

	All Intra			Random Access			Low delay B		
	G/Y	B/U	R/V	G/Y	B/U	R/V	G/Y	B/U	R/V
RGB, text & graphics with motion, 1080p	-9.6%	-9.7%	-9.8%	-6.1%	-6.0%	-6.1%	-4.9%	-4.7%	-4.8%
RGB, text & graphics with motion, 720p	-6.4%	-6.7%	-6.6%	-4.0%	-4.1%	-4.2%	-1.8%	-1.7%	-1.6%
RGB, mixed content, 1440p	-4.1%	-4.0%	-4.0%	-2.5%	-2.5%	-2.5%	-1.5%	-1.9%	-1.6%
RGB, mixed content, 1080p	-4.2%	-4.1%	-4.1%	-2.7%	-2.9%	-2.8%	-1.8%	-1.2%	-1.8%
RGB, Animation, 720p	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	0.0%	-0.1%	0.1%
RGB, camera captured, 1080p	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	0.0%	-0.1%	0.0%	0.0%
YUV, text & graphics with motion, 1080p	-9.5%	-9.8%	-9.7%	-5.9%	-6.2%	-6.2%	-4.7%	-4.9%	-4.8%
YUV, text & graphics with motion, 720p	-6.6%	-6.9%	-6.9%	-4.1%	-4.3%	-4.2%	-1.6%	-1.3%	-1.8%
YUV, mixed content, 1440p	-4.1%	-4.3%	-4.3%	-2.5%	-2.9%	-3.0%	-1.7%	-1.9%	-2.2%
YUV, mixed content, 1080p	-4.4%	-4.5%	-4.5%	-3.2%	-3.3%	-3.1%	-1.2%	-2.1%	-1.6%
YUV, Animation, 720p	-0.3%	-0.4%	-0.4%	-0.2%	-0.4%	-0.2%	-0.2%	-0.5%	-0.4%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.1%
Enc Time[%]	128%			104%			101%		
Dec Time[%]	90%			99%			100%		

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Conclusions

- This contribution proposes a BV/MV derivation process
- Proposed method is used to improve IBC merge mode and IBC normal mode
- Significant coding efficiency improvement observed for SCC sequences
- For example, for "RGB, text & graphics with motion, 1080p"
  - AI: {-9.6%, -9.7%, -9.8%}
  - RA: {-4.9%, -4.7%, -4.8%}
  - LD: {-6.1%, -6.0%, -6.1%}

Thanks Microsoft for cross-checking!
(JCTVC-R0289)

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