

JCTVC-T0116 Non-CE2: encoder improvements on IBC search

Yuwen He, Xiaoyu Xiu, Yan Ye
20th JCT-VC meeting, Feb. 2015

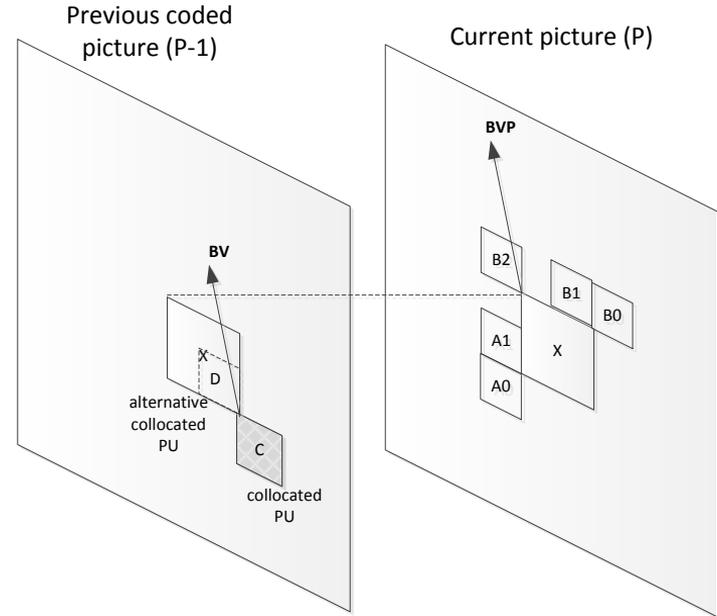
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Creating the Living Network

Proposed encoder change #1

1. Adding one BV predictor from previous coded picture used in predictors based IBC search

- If collocated PU "C" is coded as IBC, then its BV is used for current PU "X" for predictors based IBC search. If "C" is not available, alternative collocated PU "D" will be checked.
- Applied in AI coding configuration.



Proposed encoder change #2

2. Modified hash generation method for hash based IBC search

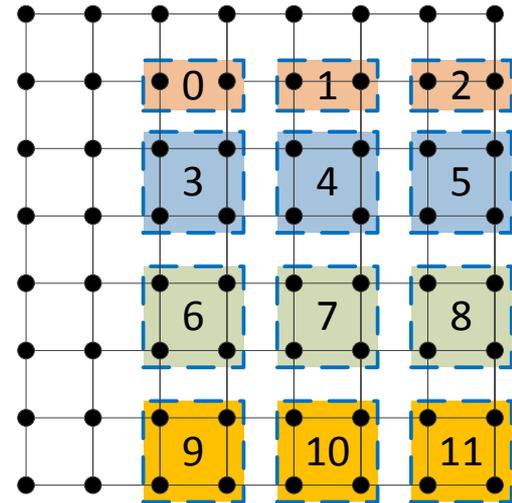
- Partition 8x8 block into 12 sub-blocks, and calculate one flag for each sub-block by comparing sub-block (local) DC with block (global) DC

$$F(SB_i) = \begin{cases} 1, & \text{if } DC(SB_i) > DC(B) \\ 0, & \text{otherwise} \end{cases}$$

- Concatenate 12 flags and 3 MSB bits of gradient to generate 15 bits hash value.

$$H(B) = \left(\sum_{i=0}^{11} F(SB_i) \ll (i + 3) \right) + MSB(Grad(B), 3)$$

- Localized hash feature allows to reduce # block candidates having the same hash value in hash table



Proposed encoder changes #3 and #4

3. Use Y instead of G for hash value generation for RGB coding

- Currently for RGB coding, YCgCo is used in spatial IBC search and chroma refinement in hash based search, while G is used to in hash value generation: propose to unify

4. Adding $N \times 2N / 2N \times N$ partition checking

- To reduce the complexity, only applied to predictor based search
- For I slices, add $N \times 2N$ checking for 32×32 CU
- For P/B slice, add $N \times 2N$ and $2N \times N$ if CU size is no larger than 32×32

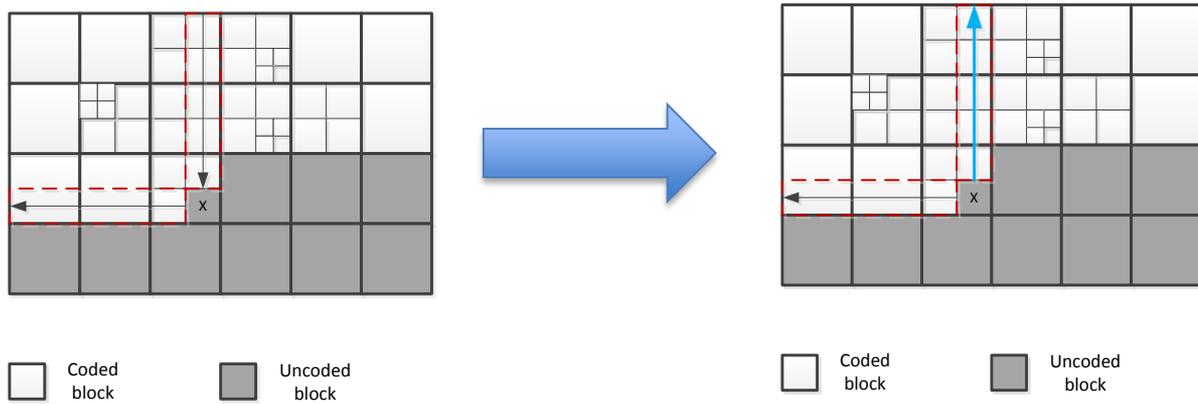
Proposed encoder change #5

5. Changing the early termination condition for IBC search

- In SCM-3.0, if quantized residual of current best mode are all zeros, then IBC search will be skipped: too aggressive and causes performance loss
- Propose the following early termination conditions:
 - 1) If the current best mode is skip mode, then all IBC search will be skipped.
 - 2) After predictor based IBC search is performed, if the current best mode is IBC and quantized residual are all zeros, then spatial and hash based IBC search will be skipped.

Proposed encoder change #6

6. Changing the vertical search order in 1-D spatial IBC search



Performance evaluation for 444 lossy coding (SCM-3.0 anchor)

	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 & 720p	-2.0%	-1.9%	-1.9%	-2.0%	-1.6%	-1.5%	-2.0%	-1.3%	-1.3%
RGB, mixed content, 1440p & 1080p	-1.4%	-1.3%	-1.4%	-0.6%	-0.6%	-0.7%	-0.6%	-0.3%	-0.4%
RGB, Animation, 720p	0.0%	-0.1%	-0.1%	0.0%	0.0%	0.0%	0.0%	-0.1%	-0.2%
RGB, camera captured, 1080p	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
YUV, text & graphics with motion, 1080p & 720p	-2.1%	-2.0%	-1.9%	-2.1%	-2.1%	-2.0%	-2.1%	-1.7%	-1.5%
YUV, mixed content, 1440p & 1080p	-1.2%	-1.1%	-1.1%	-0.8%	-0.6%	-0.6%	-1.0%	-0.9%	-0.7%
YUV, Animation, 720p	-0.1%	-0.2%	-0.2%	-0.2%	-0.4%	0.0%	0.0%	0.1%	0.1%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%	0.0%	0.0%	-0.1%	-0.1%	0.0%	0.0%
Enc Time[%]		99%			96%			95%	
Dec Time[%]		95%			95%			97%	

Performance evaluation for 444 lossless coding (SCM-3.0 anchor)

	All Intra				Random Access				Low Delay B			
	Bit-rate change (Total)	Bit-rate change (Avg.)	Bit-rate change (Min)	Bit-rate change (Max)	Bit-rate change (Total)	Bit-rate change (Avg.)	Bit-rate change (Min)	Bit-rate change (Max)	Bit-rate change (Total)	Bit-rate change (Avg.)	Bit-rate change (Min)	Bit-rate change (Max)
RGB, text & graphics with motion, 1080p & 720p	-0.9%	-1.0%	-2.2%	-0.2%	-0.5%	-0.8%	-2.2%	0.0%	-0.4%	-1.0%	-3.7%	0.0%
RGB, mixed content, 1440p & 1080p	-0.9%	-0.9%	-1.5%	-0.3%	-0.1%	-0.1%	-0.3%	0.0%	-0.1%	-0.1%	-0.1%	0.0%
RGB, Animation, 720p	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RGB, camera captured, 1080p	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
YUV, text & graphics with motion, 1080p & 720p	-0.9%	-1.0%	-2.2%	-0.3%	-0.5%	-0.7%	-2.2%	0.0%	-0.4%	-0.9%	-3.7%	0.0%
YUV, mixed content, 1440p & 1080p	-0.9%	-0.9%	-1.5%	-0.3%	-0.1%	-0.1%	-0.3%	0.0%	-0.1%	-0.1%	-0.1%	0.0%
YUV, Animation, 720p	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Enc Time[%]	94%				95%				96%			
Dec Time[%]	98%				102%				102%			

Performance evaluation for 420 lossy and lossless coding (SCM-3.0 anchor)

	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
Text & graphics with motion, 720p	-2.7%	-2.7%	-2.6%	-1.0%	-0.9%	-0.9%	-0.8%	-1.3%	-1.6%
Mixed content, 480p	-0.3%	-0.4%	-0.4%	-0.2%	-0.2%	-0.4%	0.2%	-0.1%	0.2%
Animation, 768p	-0.2%	-0.2%	-0.2%	-0.2%	0.0%	0.0%	-0.1%	0.1%	0.5%
Average of all sequences	-1.5%	-1.5%	-1.4%	-0.6%	-0.5%	-0.5%	-0.4%	-0.7%	-0.7%
Enc Time[%]	106%			95%			94%		
Dec Time[%]	94%			93%			94%		

	All Intra				Random Access				Low Delay B			
	Bit-rate change (Total)	Bit-rate change (Avg.)	Bit-rate change (Min)	Bit-rate change (Max)	Bit-rate change (Total)	Bit-rate change (Avg.)	Bit-rate change (Min)	Bit-rate change (Max)	Bit-rate change (Total)	Bit-rate change (Avg.)	Bit-rate change (Min)	Bit-rate change (Max)
Text & graphics with motion, 720p	-1.9%	-1.9%	-3.1%	-0.7%	-0.2%	-0.3%	-0.5%	-0.1%	-0.1%	-0.1%	-0.1%	0.0%
Mixed content, 480p	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Animation, 768p	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Average of all sequences	-0.6%	-0.9%	-3.1%	0.0%	0.0%	-0.2%	-0.5%	0.0%	0.0%	0.0%	-0.1%	0.0%
Enc Time[%]	89%				92%				92%			
Dec Time[%]	86%				100%				96%			

Conclusions

- This contribution proposes six encoder modifications for IBC search
 - Improve the coding performance
 - Improve encoding speed for most cases
- For “RGB/YUV, text & graphics with motion, 1080p & 720p” 444 lossy coding
- For “text & graphics with motion, 720p” 420 lossy coding

444	Applied In SCM-3.0	Applied In CE-2 Test-1	
		SCM-3.0 as anchor	CE-2 Test-1 as anchor
AI	-2.1%, -2.0%, -1.9%	-2.3%, -3.6%, -3.5%	-1.6%, -1.6%, -1.5%
RA	-2.0%, -1.8%, -1.8%	-3.7%, -5.5%, -5.5%	-1.5%, -1.6%, -1.5%
LD	-2.1%, -1.5%, -1.4%	-4.1%, -5.6%, -5.8%	-1.8%, -1.8%, -2.0%

420	Applied In SCM-3.0	Applied In CE-2 Test-1	
		SCM-3.0 as anchor	CE-2 Test-1 as anchor
AI	-2.7%, -2.7%, -2.6%	-4.6%, -5.0%, -5.1%	-1.9%, -2.1%, -2.1%
RA	-1.0%, -0.9%, -0.9%	-3.1%, -4.0%, -3.8%	-1.0%, -0.9%, -0.9%
LD	-0.8%, -1.3%, -1.6%	-2.3%, -3.0%, -3.7%	-1.0%, -2.0%, -1.0%

**Thanks Microsoft for cross-checking!
(JCTVC-T0164)**