

JVET-L0646

CE4-related: Generalized bi-prediction improvements combined from JVET-L0197 and JVET-L0296

Authors:

Yu-Chi Su, ChingYeh Chen, Yu-Wen Huang, Shaw-Min Lei (MediaTek)

Yuwen He, Jiancong Luo, Xiaoyu Xiu, Yan Ye (InterDigital)

Presenter: Ching-Yeh Chen

Overall Summary

- Proposed one combined solution based on JVET-L0197 and JVET-L0296 to further improve the generalized bi-prediction (GBi) performance
 - GBi encoder bug fix
 - Five encoder speed-up methods
 - CU size constraint for GBi
- Reported BD-rate number and encoding/decoding time

		Over BMS2.1 with VTM configuration		
		Y BD-rate	Enc. Time	Dec. Time
GBi in BMS2.1 version	RA	-0.68%	115%	102%
Proposed GBi	RA	-0.66%	107%	100%

Introduction

- Current GBi design in BMS2.1
 - Bi-prediction is generated with one weighting parameter signaled for the coding unit

$$P_{bi-pred} = ((8 - w) * P_0 + w * P_1 + 4) \gg 3$$

- Five weights for low delay pictures: $\{-2/8, 3/8, 4/8, 5/8, 10/8\}$
- Three weights for non-low-delay pictures: $\{3/8, 4/8, 5/8\}$
- GBi weight is determined based on RD cost
- GBi is also combined with other coding tools, such as affine motion models and adaptive motion vector resolution (AMVR)
- GBi in BMS2.1: 0.68% gain with 115% encoding time in RA

Encoder Bugfix for Affine ME with GBi Enabled

- Affine ME with multiple GBi weights
 - Perform affine ME with equal GBi weight first, and store those uni-prediction affine MVs
 - For unequal GBi weight, affine uni-prediction search reuses those stored affine MVs found for equal GBi weight
- BMS2.1 encoder stores uni-prediction affine MVs of 6-parameter and 4-parameter affine models to the same buffer
 - Those stored 4-parameter affine MVs may be overwritten by 6-parameter affine MVs and may be reused for 4-parameter affine ME for unequal GBi weights.
- The fix is to store uni-prediction affine MVs for equal GBi weight to different buffers according to affine type
 - The encoder reuses corresponding stored affine MVs based on affine type

Encoder Speed-up Methods

- 1) Skipping affine motion estimation for some GBi weights conditionally
 - The encoder will skip affine ME for all unequal GBi weights if explicit affine mode is not selected as the best mode after the encoding with equal GBi weight
- 2) Reducing the number of weights for RD cost checking for low-delay pictures in the encoding for 1-pel and 4-pel MVD precision
 - Order those unequal weights according to their RD cost in 1/4-pel MVD precision; Only the first two weights with the smallest RD costs, together with equal GBi weight, will be evaluated during the encoding in 1-pel and 4-pel MVD precisions

Encoder Speed-up Methods

- 3) Conditionally skipping bi-prediction search when the L0 and L1 reference pictures are the same
 - Two reference pictures in bi-prediction are the same
 - Temporal layer is greater than 1
 - The MVD precision is 1/4-pel
- 4) Skipping RD cost checking for unequal GBi weight based on temporal layer and the POC distance between reference picture and current picture
 - Temporal layer is equal to 4
 - POC distance of reference picture and current picture is equal to 1

Encoder Speed-up Methods

5) Changing floating-point calculation to fixed-point calculation for unequal GBi weight during ME

- The target for bi-prediction search is modified for unequal weights as

$$T = ((O \ll 3) - w * P_1) * (1/(8 - w))$$

w is the weight for list-1 prediction; the term $(1/(8 - w))$ is stored in floating point precision.

- Changing to fixed-point calculation

$$T = (O * a_1 - P_1 * a_2 + round) \gg N$$

CU Size Constraint

- In advanced motion vector prediction (AMVP) mode, if bi-prediction is used and the CU size is smaller than 128 luma samples, then GBi is disabled without any signaling

Simulation Results

Table1. Proposed Methods with size constraint equal to 128

	Random Access Main 10				
	Over VTM-2.1				
	Y	U	V	EncT	DecT
Class A1	-0.56%	-0.96%	-0.90%	109%	95%
Class A2	-0.78%	-1.12%	-1.00%	110%	98%
Class B	-0.92%	-1.03%	-0.96%	109%	102%
Class C	-0.43%	-0.44%	-0.38%	109%	100%
Class E					
Overall	-0.69%	-0.88%	-0.80%	109%	99%
Class D	-0.38%	-0.20%	-0.42%	109%	101%
Class F (optional)	#VALUE!	#VALUE!	#VALUE!	#NUM!	#NUM!

	Low delay B Main10				
	Over VTM-2.1				
	Y	U	V	EncT	DecT
Class A1					
Class A2					
Class B	-0.45%	-0.54%	-0.78%	106%	98%
Class C	-0.29%	-0.32%	0.09%	107%	99%
Class E	-0.13%	-0.22%	-0.40%	107%	103%
Overall	-0.32%	-0.39%	-0.39%	107%	100%
Class D	-0.14%	0.21%	-0.38%	108%	100%
Class F (optional)	#VALUE!	#VALUE!	#VALUE!	#NUM!	#NUM!

Simulation Results

Table1. Proposed Methods with size constraint equal to 256

	Random Access Main 10				
	Over VTM-2.1				
	Y	U	V	EncT	DecT
Class A1	-0.59%	-0.93%	-0.80%	107%	101%
Class A2	-0.73%	-1.06%	-0.92%	108%	99%
Class B	-0.88%	-0.93%	-0.95%	107%	100%
Class C	-0.38%	-0.31%	-0.32%	107%	100%
Class E					
Overall	-0.66%	-0.79%	-0.75%	107%	100%
Class D	-0.38%	-0.28%	-0.22%	107%	102%
Class F (optional)	#VALUE!	#VALUE!	#VALUE!	#NUM!	#NUM!

	Low delay B Main10				
	Over VTM-2.1				
	Y	U	V	EncT	DecT
Class A1					
Class A2					
Class B	#VALUE!	#VALUE!	#VALUE!	#NUM!	#NUM!
Class C	-0.28%	-0.07%	0.18%	105%	101%
Class E	-0.14%	-0.50%	-0.06%	106%	102%
Overall	#VALUE!	#VALUE!	#VALUE!	#NUM!	#NUM!
Class D	-0.10%	0.40%	-0.41%	106%	101%
Class F (optional)	#VALUE!	#VALUE!	#VALUE!	#NUM!	#NUM!

Conclusions

- Proposed one combined solution based on JVET-L0197 and JVET-L0296 to further improve the GBi performance.
 - Include encoder bug fix, CU size constraints, and several encoding algorithm improvements
 - The GBi encoding time reduced with small coding efficiency loss.
 - GBi has negligible impact on decoding complexity

		Over BMS2.1 with VTM configuration		
		Y BD-rate	Enc. Time	Dec. Time
Generalized Bi-prediction	RA	-0.66%	107%	100%

- Thank Foxconn for cross-checking the results

Thank You