

JVET-K0187

Low Latency Template based Motion Vector Refinement

Fangdong Chen and Li Wang

Hikvision

Outline

- Motivation
- Proposed Low Latency MVR
- Experimental Results
- Conclusion

Motivation

- The limited number of candidates for Merge mode provide insufficient motion reference
- Simply increasing the number brings extra bits consumption as well as the large encoding complexity

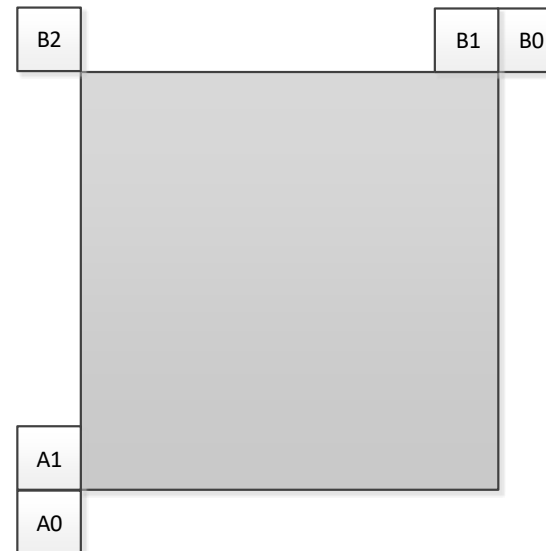


Fig 1. Merge candidates (part)

Introduction

- Bilateral matching requires two lists, thus it is invalid for P frame
- Template matching is universal while brings decoding delay if using neighboring rec. samples.

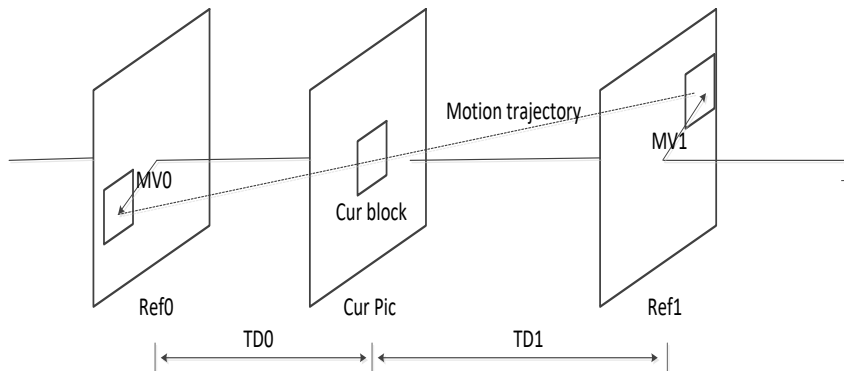


Fig 2. Bilateral matching

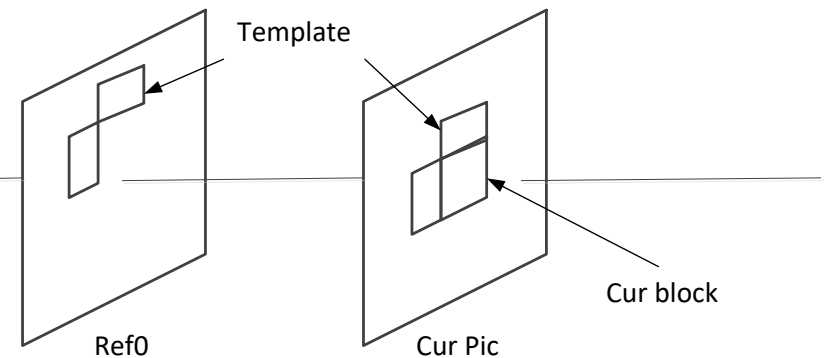


Fig 3. Template matching

- Framework
 - Generate template only with neighboring motion
 - Simply search centered on the initial MV of a Merge candidate
 - Encode one flag signaling whether MVR is enabled
 - The initial MV will be stored instead of refined MV if the Merge candidate is a spatial candidate

Template Generation

- TM1 and TM2 are obtained with interpolation using MV, Ref. index, and inter direction of one neighboring PU.

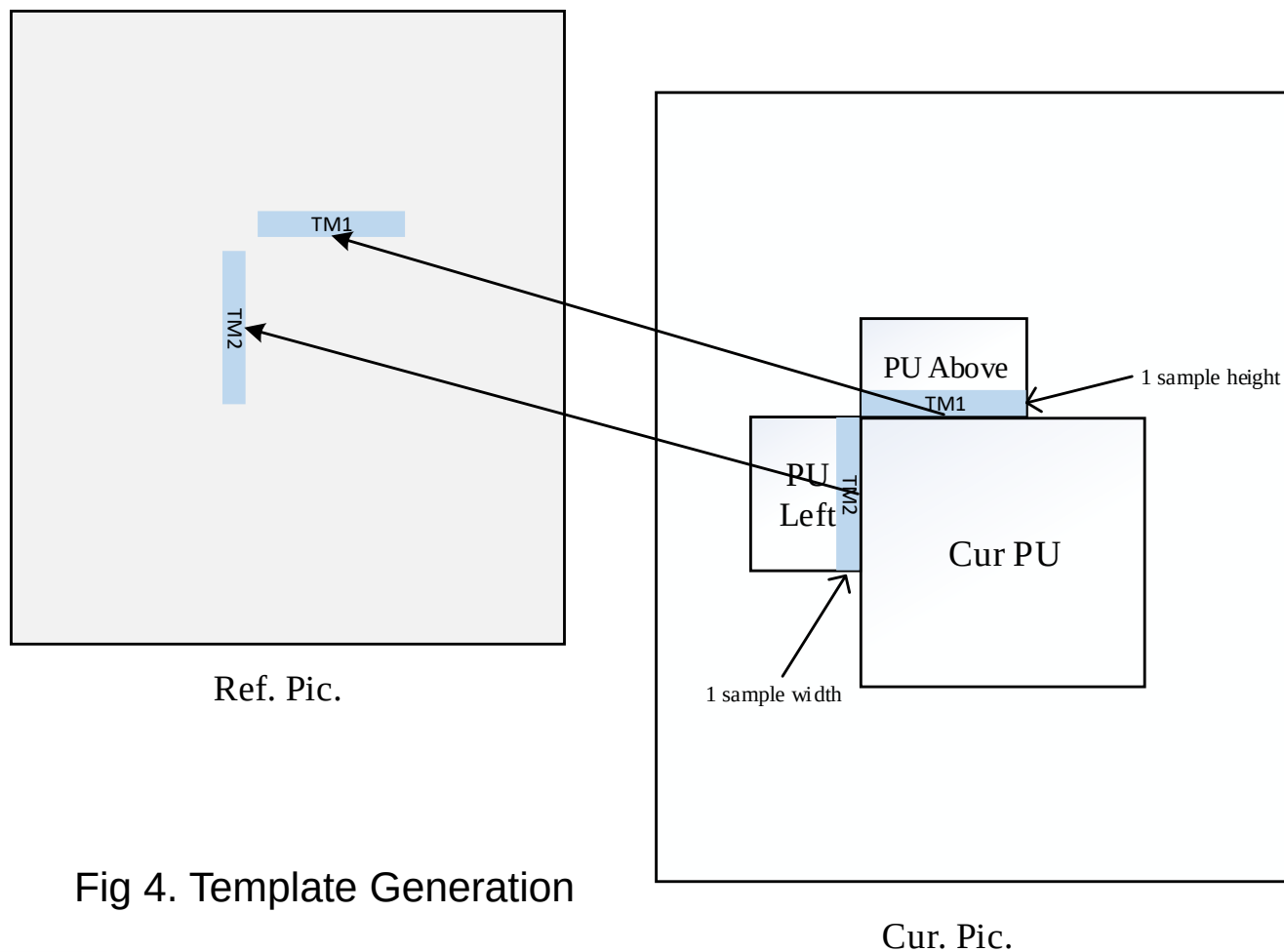


Fig 4. Template Generation

- At most four iterations with different step sizes (Max. 1 p.)
- Each iteration adopts 4 points cross search strategy, and the best point will be the start point of next iteration.
- If two continuous iterations have the same cost (SAD), search will stop, and the final MV is determined.
 - Number of SAD calculation: Max. 16, Min. 8

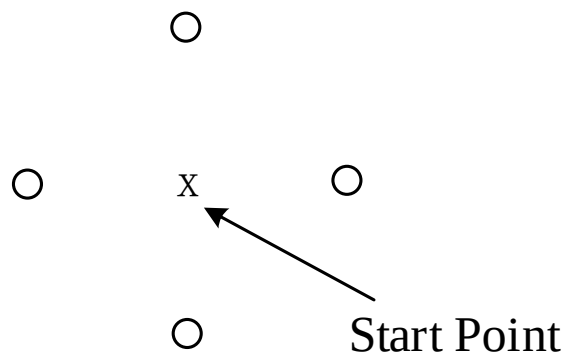


Fig 5. Cross Search

Related Issues Summary

Initial MV signaled	YES
Neighboring recon. samples used	NO
Max number of SAD calculation	16
Max. search range	~1 pixel
Cost function	SAD
Interpolation filter/tap number	DCTIF/8

Experimental Results

- Results for LDP Main10 (The refined MV is always stored)

	Low delay P Main10									
	Over VTM-1.0					Over BMS-1.0				
	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
Class A1										
Class A2										
Class B	-2.67%	-0.57%	-0.58%	135%	103%	-0.81%	-0.28%	-0.48%	114%	101%
Class C	-3.66%	-1.52%	-1.74%	140%	107%	-1.15%	-0.88%	-1.16%	115%	102%
Class E	-1.88%	-0.74%	-0.83%	138%	106%	-0.52%	-0.15%	-1.24%	119%	102%
Overall	-2.80%	-0.93%	-1.03%	137%	105%	-0.85%	-0.44%	-0.90%	116%	101%
Class D	-4.61%	-2.70%	-2.27%	143%	111%	-1.09%	-0.37%	-1.07%	117%	107%

Thank Peking University for the cross-checking!

Experimental Results

■ Results for RA Main10

	Random Access Main 10									
	Over VTM-1.0					Over BMS-1.0				
	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
Class A1	-0.17%	-0.14%	-0.11%	127%	101%	-0.61%	-0.44%	-0.53%	114%	103%
Class A2	-0.41%	-0.42%	-0.34%	139%	105%	-1.26%	-0.88%	-1.08%	120%	107%
Class B	-0.57%	-0.32%	-0.25%	144%	102%	-1.01%	-0.71%	-0.69%	120%	108%
Class C	-0.61%	-0.27%	-0.28%	156%	105%	-0.99%	-0.77%	-0.83%	122%	109%
Class E										
Overall	-0.47%	-0.29%	-0.25%	143%	103%	-0.97%	-0.71%	-0.78%	119%	107%
Class D	-0.45%	-0.04%	-0.31%	172%	106%	-0.96%	-1.01%	-1.07%	126%	110%

■ Results for LDB Main10

	Low delay B Main10									
	Over VTM-1.0					Over BMS-1.0				
	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
Class A1										
Class A2										
Class B	-0.23%	0.26%	0.38%	152%	101%	-0.07%	-0.22%	0.22%	123%	102%
Class C	-0.66%	0.15%	0.16%	157%	105%	-0.24%	-0.06%	-0.27%	125%	103%
Class E	0.15%	0.63%	0.02%	151%	103%	0.06%	-0.52%	-0.62%	124%	104%
Overall	-0.28%	0.32%	0.22%	153%	103%	-0.09%	-0.24%	-0.15%	124%	103%
Class D	-0.93%	0.09%	0.12%	160%	107%	-0.20%	-0.05%	0.10%	128%	107%

Experimental Results

- Results for LDP Main10
- The initial MV is stored for spatial Merge candidate

	Low delay P Main10									
	Over VTM-1.0					Over BMS-1.0				
	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
Class A1										
Class A2										
Class B	-1.77%	0.06%	-0.29%	135%	107%	-0.18%	0.01%	-0.15%	115%	101%
Class C	-2.60%	-0.92%	-1.21%	139%	104%	-0.39%	-0.25%	-0.55%	116%	103%
Class E	-1.21%	-0.07%	-0.65%	138%	102%	-0.01%	0.31%	-0.53%	120%	103%
Overall	-1.91%	-0.30%	-0.69%	137%	105%	-0.21%	0.00%	-0.38%	116%	102%
Class D	-3.42%	-2.03%	-1.43%	142%	110%	-0.28%	0.45%	-0.06%	118%	109%

Conclusion

- Propose a Low Latency Template based Motion Vector Refinement method
 - Low latency because of the reuse of neighboring motion and constrained MV storage
 - Low decoder complexity increase because of the small size of template
 - 2.80% BD-rate savings when refined MV is stored
 - 1.91% BD-rate savings with constrained MV storage
- Based on the above results, it is suggested to study it in the related CE.

Thank you !

