

JVET-L0171 CE4-related: Merge mode with Regression based Motion Vector Field (RMVF)

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Merge mode with Regression based Motion Vector Field (RMVF)

- In order to provide a fine granularity of motion vectors inside a block, Regression based Motion Vector Field (RMVF) tool is proposed.
- This tool attempts to model the motion vectors of each block on a sub-block level based on the spatially neighboring motion vectors.
- In RMVF mode, motion of the block is defined by a 6-parameter motion model as below:

$$\begin{bmatrix} MV_{X_subPU} \\ MV_{Y_subPU} \end{bmatrix} = \begin{bmatrix} a_{xx} & a_{xy} \\ a_{yx} & a_{yy} \end{bmatrix} \begin{bmatrix} X_{subPU} \\ Y_{subPU} \end{bmatrix} + \begin{bmatrix} b_x \\ b_y \end{bmatrix}$$

$(MV_{X_subPU}, MV_{Y_subPU})$: Motion vectors of an 8×8 sub-block

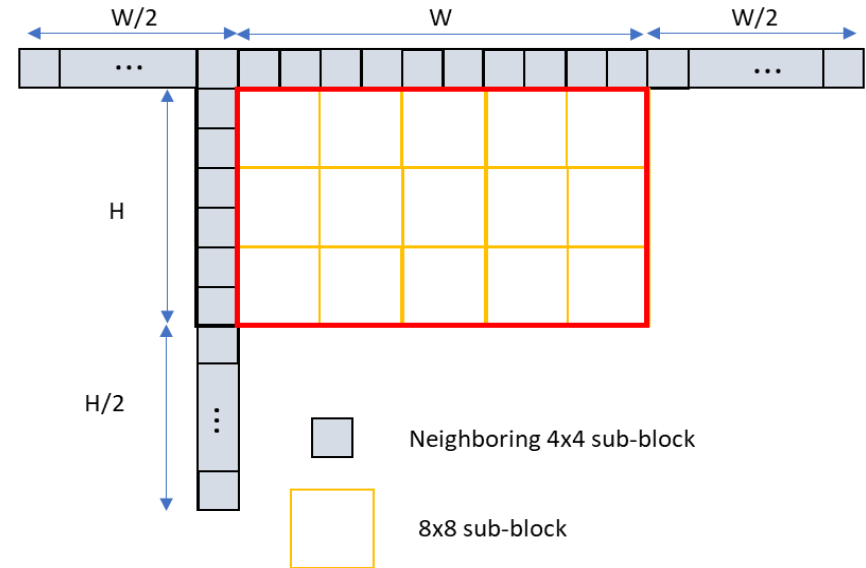
(X_{subPU}, Y_{subPU}) : Center location of an 8×8 sub-block

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The model parameters (a_{xx} , a_{xy} , a_{yx} , a_{yy} , b_x and b_y) are calculated by solving a linear regression model in mean square error (MSE) sense.

The input to the regression model consists of the center locations (x , y) and motion vectors (mv_x and mv_y) of the available neighboring 4×4 sub-blocks as defined above.

One line and row of immediate neighboring motion vectors in 4×4 sub-block basis are used in the RMVF parameter derivation.



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Further details:

- The minimum coding unit size for RMVF mode is 8×8
- Decision for uni- or bi-directional prediction is done based on the picture type (P/B picture) and availability of neighboring motion information for that prediction direction.
- Reference index in both prediction directions is set to 0.
- When calculating the motion parameters, the conventional motion vector scaling used in VTM-2.0.1 is applied to the motion vectors that have different reference pictures than the current block.
- All the calculated sub-block motion vectors are set to be in high precision.
- The sub-block motion compensation is done as in VTM-2.0.1 (but with 8×8 sub-block size).

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Further details (Cont.):

- In merge mode, if the `affine_merge` is not selected, a conditional flag is signalled in the bitstream that indicates whether the RMVF tool is used in each block as a new merge mode or not. The `RMVF_flag` is signalled if at least one motion vector from at least three of the candidate regions are available.

Results

Anchor BMS-2.0.1 (with VTM configurations)

	Random Access Main 10					Low delay B Main10				
	Over VTM-2.0.1					Over VTM-2.0.1				
	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
Class A1	-0.92%	-0.78%	-0.98%	102%	99%					
Class A2	-1.00%	-1.05%	-1.22%	105%	105%					
Class B	-0.65%	-0.68%	-0.71%	106%	102%	-0.25%	-0.13%	-0.24%	107%	97%
Class C	-0.36%	-0.38%	-0.47%	107%	106%	-0.06%	0.02%	-0.24%	111%	102%
Class E						0.08%	0.24%	0.17%	109%	107%
Overall	-0.70%	-0.70%	-0.80%	105%	103%	-0.10%	0.01%	-0.14%	109%	101%
Class D	-0.56%	-0.67%	-0.70%	108%	107%	0.02%	0.64%	0.03%	110%	108%
Class F (optional)	-0.07%	-0.15%	-0.14%	107%	103%	0.06%	0.20%	0.27%	107%	103%

	Low delay P Main10				
	Over VTM-2.0.1				
	Y	U	V	EncT	DecT
Class A1					
Class A2					
Class B	-0.43%	0.09%	0.07%	108%	96%
Class C	-0.22%	-0.24%	-0.27%	112%	99%
Class E	-0.10%	0.02%	-0.06%	111%	101%
Overall	-0.28%	-0.04%	-0.08%	110%	98%
Class D	-0.05%	0.40%	0.06%	113%	108%
Class F (optional)	-0.02%	-0.24%	-0.60%	109%	101%

Merge mode with Regression based Motion Vector Field (RMVF)

This contribution proposed Regression based Motion Vector Field (RMVF) method for improving the motion vector prediction of the VTM-2.0.1 test model.

Proposed RMVF method provided on average -0.70%, -0.10% and -0.28% Luma BD-Rate improvements for RA, LDB and LDP configurations, respectively with a reasonable complexity overhead.

It is proposed to test the impact of the tool in a core experiment during the next meeting cycle.

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