
JVET-J0039

INTRA REGION-BASED TEMPLATE MATCHING

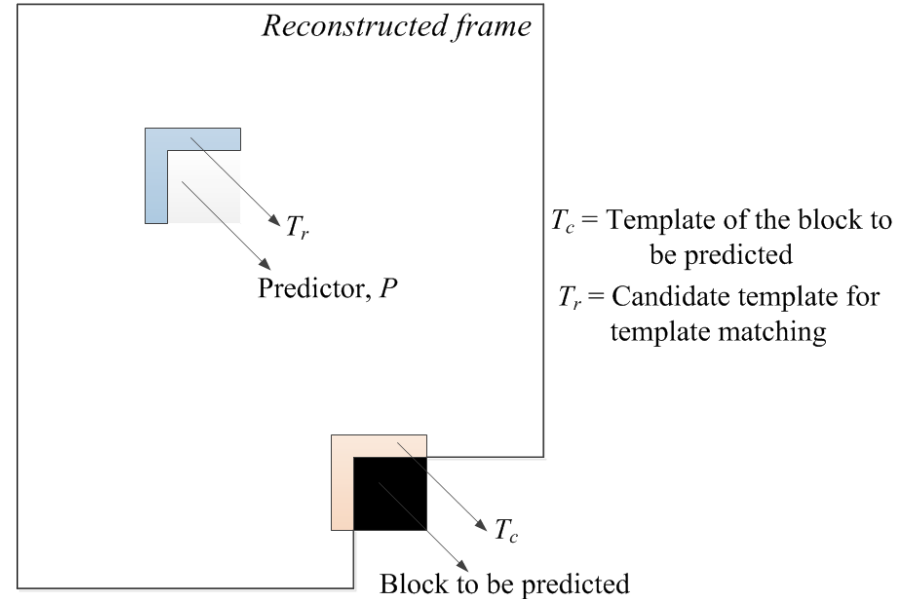
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Intra Template Matching

- A **template** refers to the samples present above and left of a block (2 samples wide)
- If the template of the current block is T_c and any template available in the reconstructed picture is T_r
- The best template T_b is the template T_r that minimizes the error metric sum of squared differences (SSD)

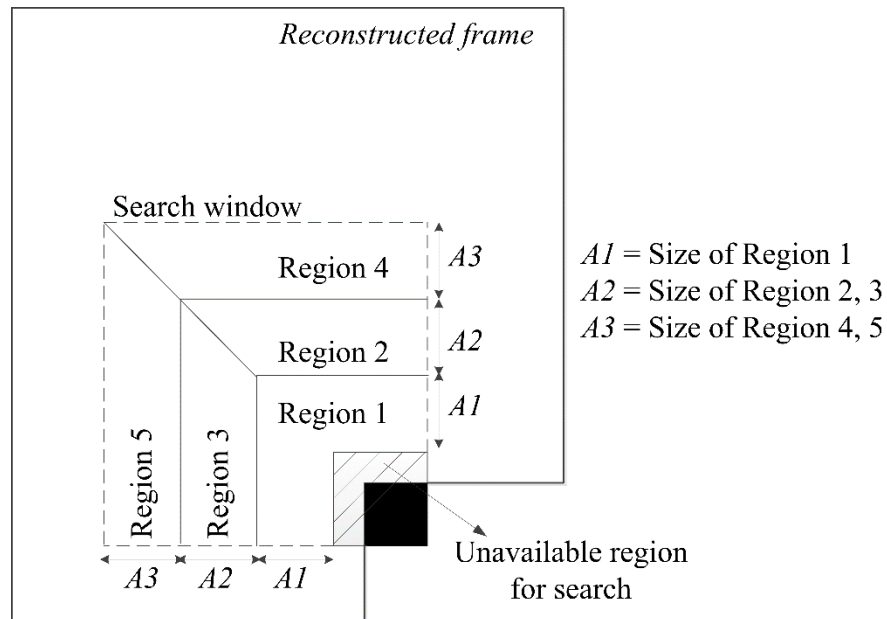
$$T_b = \arg \min_r \{ \text{SSD}(T_c, T_r) \}$$

- The block corresponding to the template T_b forms the **predictor** for the current block



Intra Region-based Template Matching (RTM)

- Intra RTM searches for the template match inside a window in the immediate neighborhood of the block to be predicted
- The search window has *five regions*
- The decoder searches only in one region indicated by the `intra_rtm_index` syntax signaled in the bitstream
- Line wise search inside regions



Intra RTM: Formation of Prediction Signal

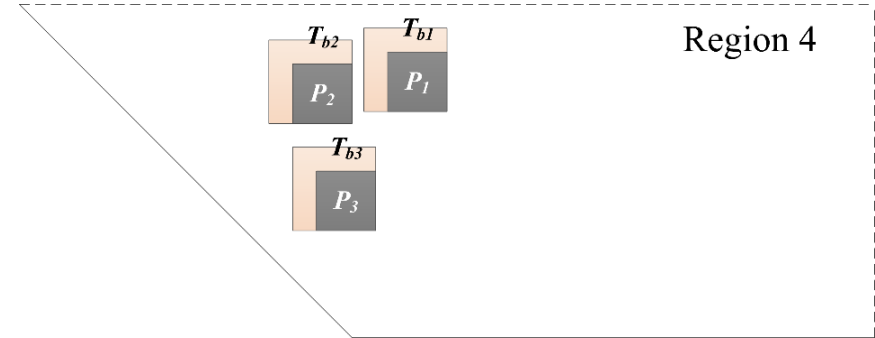
- Given a region, three template matches T_{b1} , T_{b2} and T_{b3} are found such that

$$SSD(T_c, T_{b1}) \leq SSD(T_c, T_{b2}) \leq SSD(T_c, T_{b3})$$

- Thus there are **three predictors** P_1 , P_2 and P_3 from T_{b1} , T_{b2} and T_{b3} respectively

- The final prediction signal is P_{final}

$$P_{final} = (2P_1 + P_2 + P_3) / 4$$

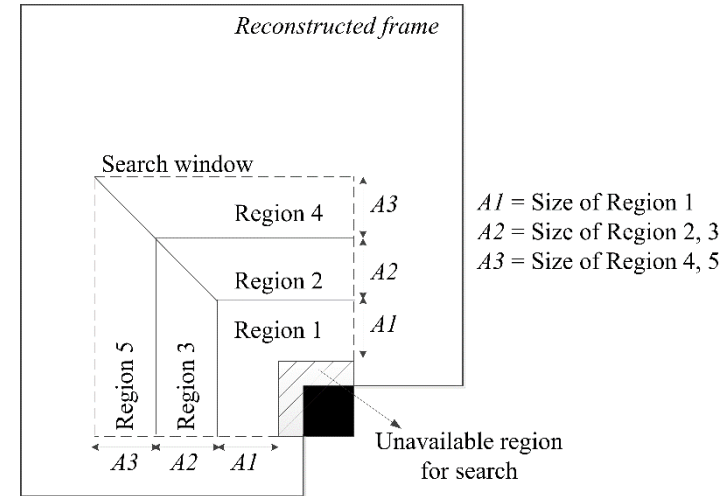


Intra RTM: Region Sizes

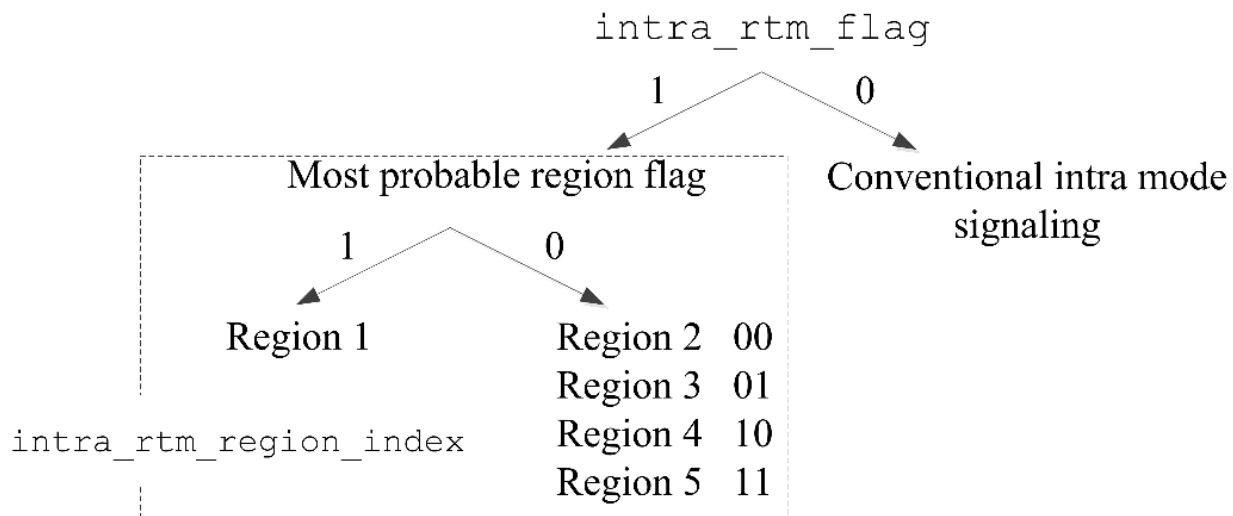
- The size of the regions depends on
 - the frame width
 - the region size parameter RSP (coded in SPS)
- In our tests: $RSP = 1$

		Frame width	Downsample search region
$A1$	$4 \times (RSP + 1)$	all frame widths	no
$A2$	$3 \times A1$	all frame widths	no
$A3$	$3 \times A2$	$0 < w \leq 1280$	no
	$6 \times A2$	otherwise	yes

Downsampling: Factor 2 in horizontal and vertical direction



Intra RTM: Syntax



Improvements after bitstream submission (version 1)

■ Modified formation of prediction signal

if $SSD(b2) \leq 2 \cdot SSD(b1)$ && $SSD(b3) \leq 2 \cdot SSD(b1)$

$$P_{final} = (2 \cdot P1 + P2 + P2) / 4$$

else if $SSD(b2) \leq 2 \cdot SSD(b1)$

$$P_{final} = (P1 + P2) / 2$$

else

$$P_{final} = P1$$

■ Modified region sizes

		Frame width	Downsample search region
A1	$4 \times (RSP + 1)$	all frame widths	no
A2	$2 \times A1$	all frame widths	no
A3	$2 \times A2$	$0 < w \leq 1280$	no
	$4 \times A2$	otherwise	yes

Improvements after bitstream submission (version 2)

■ Additional encoder only modifications

- Intra RTM mode is not tested if Cbf of best mode is equal to 0
- If first 3 regions do not yields smaller rd cost than best mode, other regions are skipped
- If, after checking the first 3 regions, region 1 has the smallest rd cost and the rd cost for the other regions exceed a threshold, the remaining two regions are not tested
- Order in which regions are tested depends on region index of neighboring CUs

■ Additional modifications of decoder search

- After defined number of lines (for a region) have been searched:
 - Compare best SSD to current SSD
 - Skip remaining lines if SSDs are very similar or very different

Experimental results: All Intra

	BDR-Y	BDR-U	BDR-V	EncT	DecT
CfP version	-2.19%	-0.54%	-0.42%	342%	185%
version 1	-2.34%	-0.77%	-0.71%	219%	134%
version 2	-1.77%	-0.93%	-0.90%	144%	115%

- Reference: QT+BTS partitioning only
- JVET + CfP test sequences
- QP values 27, 32, 37, 42
- Region size parameter RSP=1

Experimental results: Random Access

	BDR-Y	BDR-U	BDR-V	EncT	DecT
CfP version	-1.41%	0.13%	0.26%	174%	114%
version 1	-1.62%	-0.23%	-0.09%	136%	105%
version 2	-1.24%	-0.37%	-0.37%	117%	102%

- Reference: QT+BTS partitioning only
- JVET + CfP test sequences
- QP values 27, 32, 37, 42
- Region size parameter RSP=1