
JVET-L0223

CE4.6: INTRA AND INTER/INTRA BOUNDARY PADDING

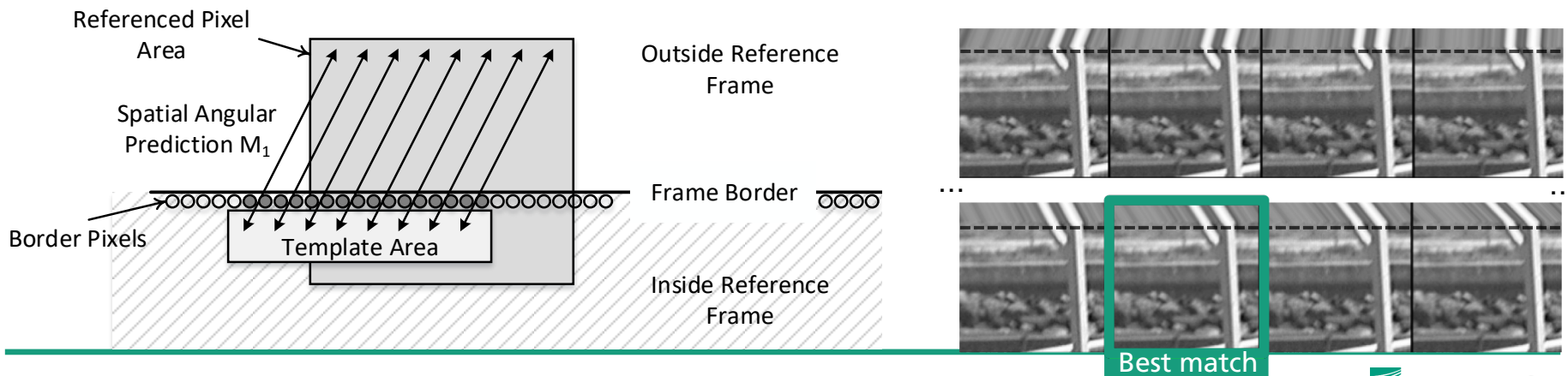
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CE4.6.2: Intra-prediction based boundary padding

■ Padding per reference (CE4.6.2):

- Fill boundary padding area with directional intra prediction (33 modes)
- Determine intra mode based on decoded samples (2 samples x block height/width)
- Performs steady independent of codec configuration (RA/LD) or TL



CE4.6.2: Intra-prediction based boundary padding

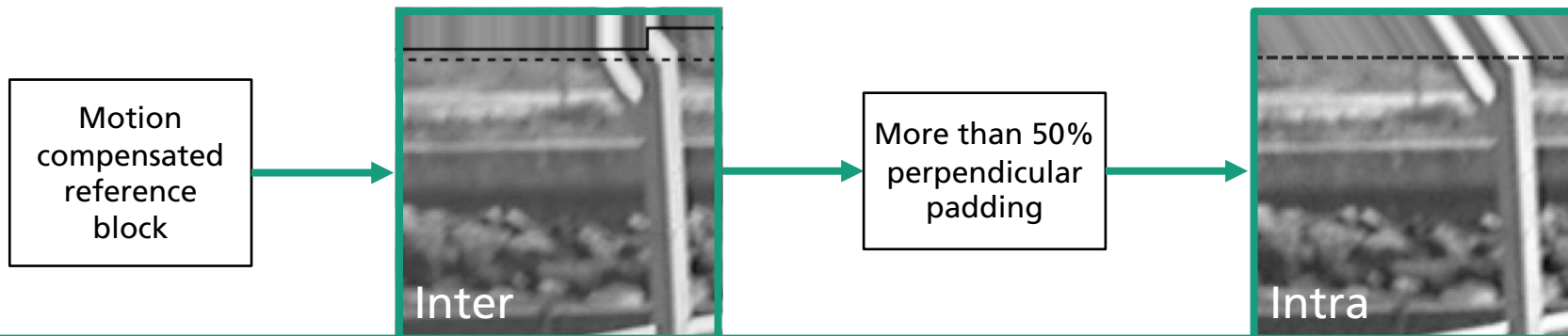
- Disabled for Affine prediction
- Luma only, chroma mode is copied from luma
- Encoder: After MV sub-pel refinement for each AMVP candidate
- Complexity
 - Cost function SAD
 - Max number of cost calculations 33
- Memory bandwidth for cost function
 - Top or bottom side: $2*2*(PU_Width+2)$
 - Left or right side: $2*2*(PU_Height+2)$

...

CE4.6.3: Inter/Intra-prediction based boundary padding

Harmonized variant between CE4.6.2 and K0363:

- **Inter-prediction** based padding per picture
- If reference block contains boundary padding samples
 - If above threshold for perpendicular padding sample ratio (50% of padding)
 - **Intra-prediction** (similar to CE4.6.2) based padding as fall back

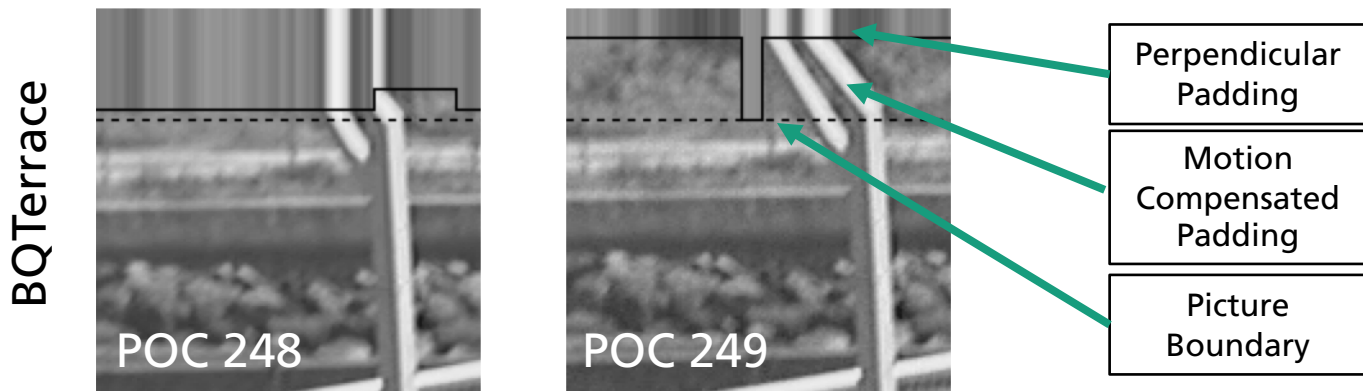


CE4.6.3: Inter/Intra-prediction based boundary padding

Inter-prediction based boundary padding

■ Padding per picture (CE4.6.3):

- Devide boundary padding area into $4 \times M$ or $M \times 4$ blocks
- Use motion info of adjacent blocks
- Perpendicular intra-prediction based padding fall back

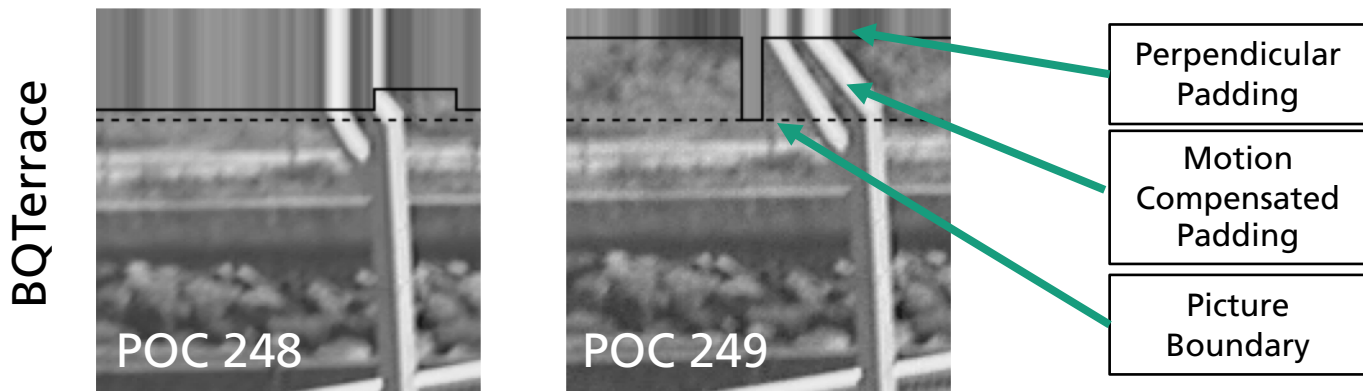


CE4.6.3: Inter/Intra-prediction based boundary padding

Inter-prediction based boundary padding

■ Padding per picture (CE4.6.3):

- Addition of average residual of adjacent block
- Max padding size: $\text{MAX_CU_Size} + 16$
- 64 luma samples inter-predicted padding, remaining samples are padded traditionally



Results – VTM 2.0.1

	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	-0.06%	-0.03%	-0.11%	102%	102%					
Class A2	-0.01%	-0.10%	-0.04%	103%	101%					
Class B	-0.05%	-0.10%	-0.08%	102%	105%	-0.04%	-0.04%	0.01%	105%	107%
Class C	-0.08%	0.00%	-0.13%	105%	111%	-0.04%	-0.08%	0.08%	108%	108%
Class E						-0.14%	-0.06%	-0.20%	100%	100%
Overall	-0.05%	-0.06%	-0.09%	103%	105%	-0.07%	-0.06%	-0.02%	105%	106%
Class D	-0.16%	-0.12%	-0.25%	109%	112%	-0.50%	-0.39%	-0.98%	116%	116%
Class F (optional)	-0.03%	-0.01%	0.04%	102%	104%	-0.25%	0.35%	-0.27%	103%	101%

	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	-0.23%	-0.12%	-0.17%	100%	103%					
Class A2	-0.16%	-0.13%	-0.16%	101%	102%					
Class B	-0.26%	-0.18%	-0.26%	101%	109%	-0.03%	-0.12%	-0.05%	105%	108%
Class C	-0.29%	-0.15%	-0.31%	104%	121%	-0.07%	-0.04%	-0.24%	107%	113%
Class E						-0.29%	-0.64%	-0.64%	99%	102%
Overall	-0.24%	-0.15%	-0.24%	102%	110%	-0.11%	-0.23%	-0.26%	104%	108%
Class D	-0.61%	-0.42%	-0.52%	106%	128%	-0.49%	-1.16%	-1.00%	115%	125%
Class F (optional)	-0.07%	-0.07%	-0.02%	102%	112%	-0.17%	0.17%	0.30%	103%	107%

Additional Experiments: Motion Constrained Tiling

- CTC with Tiles with Class A1 and A2 sequences
- 6x4 motion constrained tiles:
 - 640x512 luma samples, last tile line 640x624 luma samples
- Tile boundaries are padded for the motion compensation
- Anchor uses perpendicular padding on tile boundaries

Results – VTM-1.0

	Random Access Main 10					Low delay B Main 10				
	Over VTM-1.0					Over VTM-1.0				
	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
CampfireParty2	-0.03%	-0.13%	-0.15%	101%	102%	-0.11%	-0.41%	-0.21%	105%	103%
CatRobot1	-0.28%	-0.32%	-0.29%	104%	104%	-0.28%	-0.20%	-0.17%	110%	106%
DaylightRoad2	-0.31%	-0.37%	-0.32%	107%	105%	-0.18%	0.65%	-0.21%	113%	106%
FoodMarket4	-0.34%	-0.47%	-0.53%	107%	104%	-0.61%	-0.37%	-0.22%	118%	108%
ParkRunning3	-0.18%	-0.20%	-0.24%	108%	105%	-0.18%	-0.17%	-0.08%	115%	108%
Tango2	-0.49%	-0.51%	-0.50%	105%	108%	-0.49%	-0.23%	-0.24%	113%	107%
Overall	-0.27%	-0.33%	-0.34%	105%	105%	-0.31%	-0.12%	-0.19%	112%	106%

	Random Access Main 10					Low delay B Main 10				
	Over VTM-1.0					Over VTM-1.0				
	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
CampfireParty2	-0.13%	-0.15%	-0.25%	104%	114%	-0.05%	-0.08%	0.09%	105%	111%
CatRobot1	-0.72%	-0.70%	-0.76%	106%	122%	-0.41%	-0.37%	-0.22%	109%	114%
DaylightRoad2	-1.15%	-1.08%	-1.36%	106%	124%	-0.27%	-0.18%	0.38%	112%	117%
FoodMarket4	-1.71%	-1.67%	-1.80%	106%	128%	-0.59%	-0.10%	-0.22%	117%	118%
ParkRunning3	-0.73%	-0.70%	-0.73%	108%	124%	-0.19%	-0.18%	-0.13%	113%	113%
Tango2	-1.01%	-0.92%	-1.16%	108%	133%	-0.43%	-0.20%	-0.21%	112%	116%
Overall	-0.91%	-0.87%	-1.01%	106%	124%	-0.32%	-0.19%	-0.05%	111%	115%

Results summary

- CE4.6.2: Intra-prediction based boundary padding
 - -0,05% BD-rate gain RA, -0.07% BD-rate gain LD
- CE4.6.3: Harmonized Inter/Intra-prediction based boundary padding
 - -0,24% BD-rate gain RA; -0.61% BD-rate gain LD
- MCTS scenario:
 - CE4.6.2: -0,27% BD-rate gain RA; -0.31% BD-rate gain LD
 - CE4.6.3: -0,91% BD-rate gain RA; -0.32% BD-rate gain LD