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Corporate Technology

Simplified sample-based weighted prediction (RCE Tests C.3, D.3) (JCTVC-N0071/N0072/N0073)

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Motivation

- Lossless image compression required in professional applications

- Example application: medical imaging
  - Coding artifacts might degrade the quality of a diagnosis
    → Lossless compression is needed
  - Large amounts of medical image data that have to be archived in repositories (e.g., PACS – Picture Archiving and Communication System)
    → High coding efficiency is important

- Other application examples
  - Automotive vision
  - Video conferencing
  - Long-distance education
  - …

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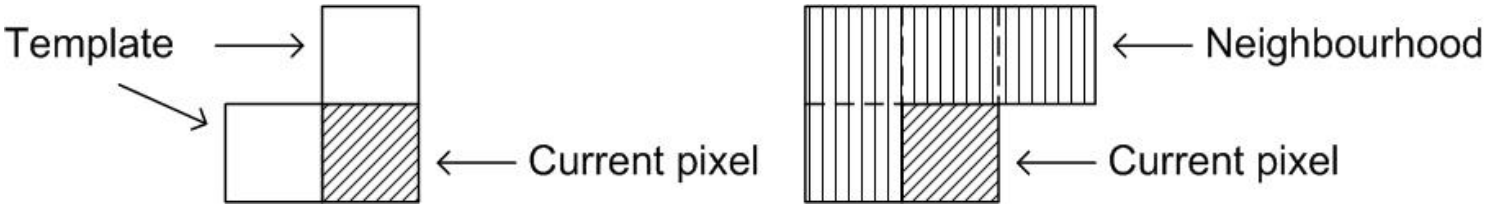
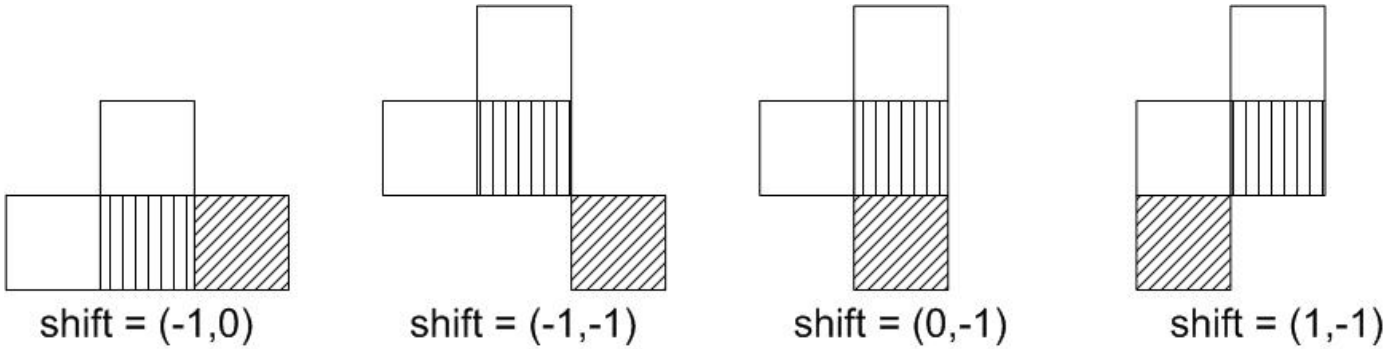
Proposal Overview

- Pixel-wise intra prediction mode replacing PLANAR mode for “transform skip”
- Two-pixel template and four-pixel neighborhood



- Similarity calculation



Proposal Algorithm

1) Similarity (i.e., SAD) between template around current pixel and template of neighbourhoud pixel:

$$SAD_{i,j} = \sum_{n \in P_0} | \, p[i+n] - p[j+n] \, |$$

$$P_o = \{ n = (x, y) \, | \, (0,-1), (-1,0) \}$$

2) Escape if SAD = 0:

$$\hat{p}[i] = p_{\text{opt}}$$

3) Weights (exponential decay) from look-up table:

$$w_{i,j} = LUT[SAD_{i,j} >> (BitDepth - 2)]$$

4) Predictor for current pixel:

$$\hat{p}[i] = \left(\sum_{j \in i+N_0} w_{i,j} \cdot p[j] + p_{\text{opt}} \cdot \left(32 - \sum_{j \in i+N_0} w_{i,j}\right) + 16 \right) >> 5$$

$$N_o = \{ n = (x, y) \, | \, (0,-1), (1,-1), (-1,0), (-1,-1) \}$$

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Simplification Compared to JVTVC-M0052/M0193

- Two-pixel template instead of four-pixel template
- Only one look-up table instead of three tables
- Nine table entries instead of 105+78+50 entries
  LUT[k] = {8, 6, 4, 3, 2, 2, 1, 1, 1}
- Division in the weighted prediction process replaced by bit shift

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Results: RCE2 Test C.3 (JCTVC-N0071)

	All Intra Main			Random Access Main			Low delay B Main		
	compression ratio		Bit-rate saving	compression ratio		Bit-rate saving	compression ratio		Bit-rate saving
	Reference	Tested		Reference	Tested		Reference	Tested	
Class F	5,2	5,4	-2,4%	31,7	32,2	-1,1%	49,8	50,3	-0,9%
Class B	2,2	2,3	-2,5%	2,6	2,6	-0,7%	2,6	2,6	-0,6%
RGB 444	10,1	10,7	-4,9%	100,4	106,7	-3,6%	381,6	409,0	-3,4%
SC YUV 444	11,4	11,9	-3,7%	128,9	134,4	-2,9%	325,6	343,8	-2,5%
RangeExt	2,4	2,4	-1,4%	2,5	2,5	-0,5%	2,5	2,5	-0,4%
Enc Time[%]	101%			100%			100%		
Dec Time[%]	105%			101%			100%		

Results: RCE2 Test D.4 (JCTVC-N0073): Combination with JCTVC-N0053 (Test C.4)

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	All Intra Main			Random Access Main			Low delay B Main		
	compression ratio		Bit-rate saving	compression ratio		Bit-rate saving	compression ratio		Bit-rate saving
	Reference	Tested		Reference	Tested		Reference	Tested	
Class F	5.2	5.5	-3.4%	31.7	32.4	-1.8%	49.8	50.5	-1.5%
Class B	2.2	2.3	-2.9%	2.6	2.6	-0.7%	2.6	2.6	-0.6%
RGB 444	10.1	10.8	-6.2%	100.4	107.6	-4.5%	381.6	415.2	-4.4%
SC YUV 444	11.4	12.1	-4.8%	128.9	135.4	-3.4%	325.6	347.7	-3.3%
RangeExt	2.4	2.4	-1.4%	2.5	2.5	-0.4%	2.5	2.5	-0.3%
Enc Time[%]	100%			98%			102%		
Dec Time[%]	101%			99%			91%		

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JCTVC-N0072: Variant 1

- Modification: Neighbor pixel with lowest SAD selected as predictor (no weighting process, no table look-up): $\hat{p}[i] = p_{\text{opt}}$
- Results

	All Intra Main			Random Access Main			Low delay B Main		
	compression ratio		Bit-rate saving	compression ratio		Bit-rate saving	compression ratio		Bit-rate saving
	Reference	Tested		Reference	Tested		Reference	Tested	
Class F	5.2	5.4	-2.2%	31.7	32.2	-1.2%	49.8	50.4	-1.0%
Class B	2.2	2.3	-0.3%	2.6	2.6	0.0%	2.6	2.6	0.0%
RGB 444	10.1	10.7	-5.3%	100.4	107.0	-4.0%	381.6	412.1	-3.8%
SC YUV 444	11.4	12.0	-4.1%	128.9	135.3	-3.3%	325.6	346.8	-3.0%
RangeExt	2.4	2.4	0.0%	2.5	2.5	0.1%	2.5	2.5	0.1%
Enc Time[%]	100%			100%			100%		
Dec Time[%]	103%			100%			100%		

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JCTVC-N0072: Variant 2

- Modification: DC mode = “best predictor” as of variant 1 (PLANAR mode as in JCTVC-N0071)
- Results

	All Intra Main			Random Access Main			Low delay B Main		
	compression ratio		Bit-rate saving	compression ratio		Bit-rate saving	compression ratio		Bit-rate saving
	Reference	Tested		Reference	Tested		Reference	Tested	
Class F	5.2	5.4	-2.8%	31.7	32.3	-1.4%	49.8	50.5	-1.2%
Class B	2.2	2.3	-2.3%	2.6	2.6	-0.5%	2.6	2.6	-0.4%
RGB 444	10.1	10.7	-5.4%	100.4	107.0	-3.9%	381.6	412.5	-3.8%
SC YUV 444	11.4	12.0	-4.4%	128.9	135.3	-3.4%	325.6	346.6	-3.1%
RangeExt	2.4	2.4	-1.1%	2.5	2.5	-0.3%	2.5	2.5	-0.3%
Enc Time[%]	102%			100%			100%		
Dec Time[%]	106%			100%			100%		

Summary

	All Intra Main			
	Bit-rate savings			
	N0071 (Test C.3) PLANAR: SWP DC: no change	N0073 (Test D.4) PLANAR: SWP DC: JCTVC-N0053	N0072 (variant 1) PLANAR: best predictor DC: no change	N0072 (variant 2) PLANAR: SWP DC: best predictor
Class F	-2,4%	-3.4%	-2.2%	-2.8%
Class B	-2,5%	-2.9%	-0.3%	-2.3%
RGB 444	-4,9%	-6.2%	-5.3%	-5.4%
SC YUV 444	-3,7%	-4.8%	-4.1%	-4.4%
RangeExt	-1,4%	-1.4%	0.0%	-1.1%
Enc Time[%]	101%	100%	100%	102%
Dec Time[%]	105%	101%	103%	106%

