

Quantized Residual BDPCM (JVET-N0413)

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Introduction

- BDPCM proposed in JVET-M0057 uses reconstructed samples to predict the rows or columns line by line (horizontal/vertical)
- The prediction error is quantized in the spatial domain.
- Pixels are reconstructed by adding the dequantized prediction error to the prediction.
- Sequential dependency in reconstructed domain
 - Inverse quantization and prediction are interleaved

Proposal (part 1)

- Perform BDPCM in quantized residual domain
- Prediction directions and signaling are identical to JVET-M0057
- Vertical BDPCM for $M \times N$ block, with residual $r_{i,j}$.

$$\tilde{r}_{i,j} = \begin{cases} Q(r_{i,j}), & i = 0, \quad 0 \leq j \leq (N - 1) \\ Q(r_{i,j}) - Q(r_{(i-1),j}), & 1 \leq i \leq (M - 1), \quad 0 \leq j \leq (N - 1) \end{cases}$$

- Horizontal BDPCM

$$\tilde{r}_{i,j} = \begin{cases} Q(r_{i,j}), & 0 \leq i \leq (M - 1), \quad j = 0 \\ Q(r_{i,j}) - Q(r_{i,(j-1)}), & 0 \leq i \leq (M - 1), \quad 1 \leq j \leq (N - 1) \end{cases}$$

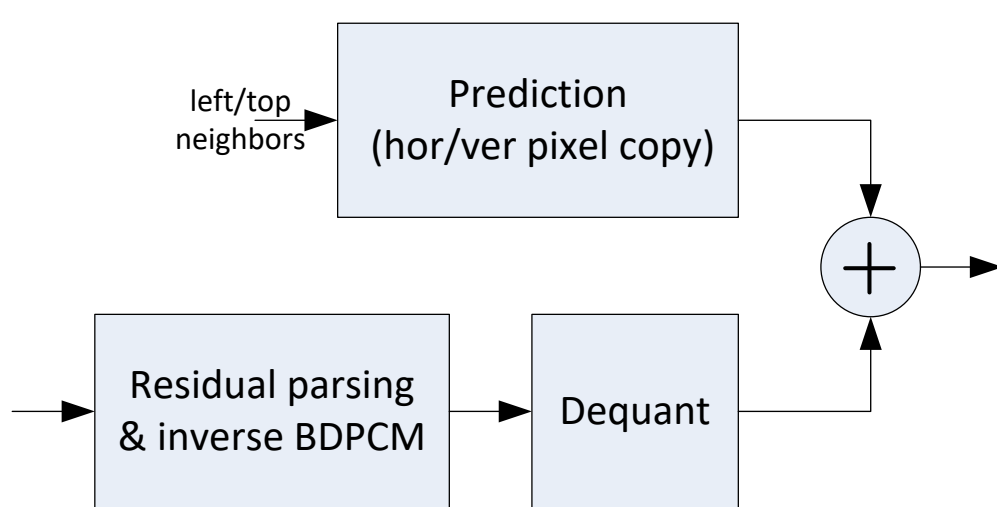
- Inverse process

$$Q(r_{i,j}) = \sum_{k=0}^i \tilde{r}_{k,j}, \quad 0 \leq i \leq (M - 1), \quad 0 \leq j \leq (N - 1). \text{ (Vertical)}$$

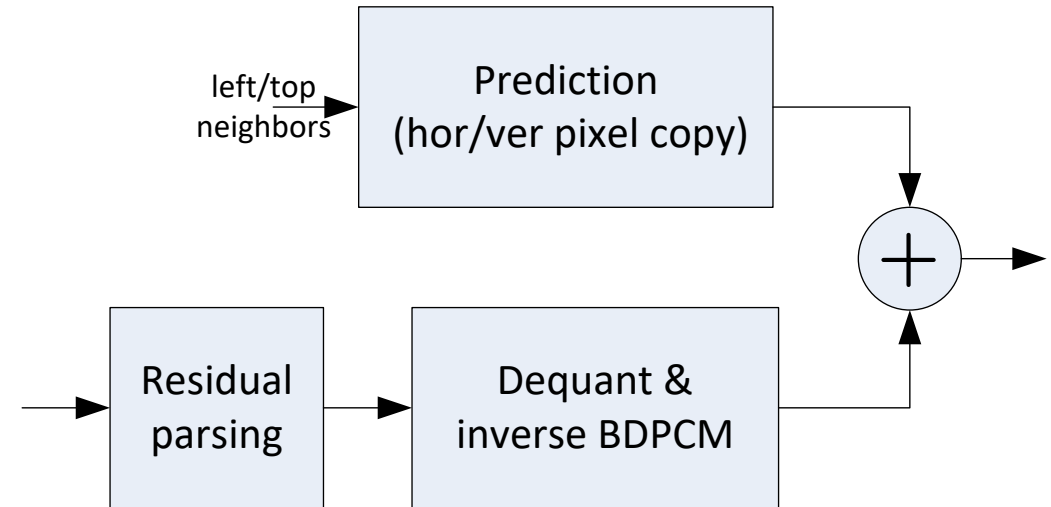
$$Q(r_{i,j}) = \sum_{k=0}^j \tilde{r}_{i,k}, \quad 0 \leq i \leq (M - 1), \quad 0 \leq j \leq (N - 1). \text{ (Horizontal)}$$

Proposal

- Inverse BDCPM can be performed during parsing process to reconstruct residual levels.
- Splitting the 4xN, Nx4 blocks into 2 may not be necessary for throughput improvement



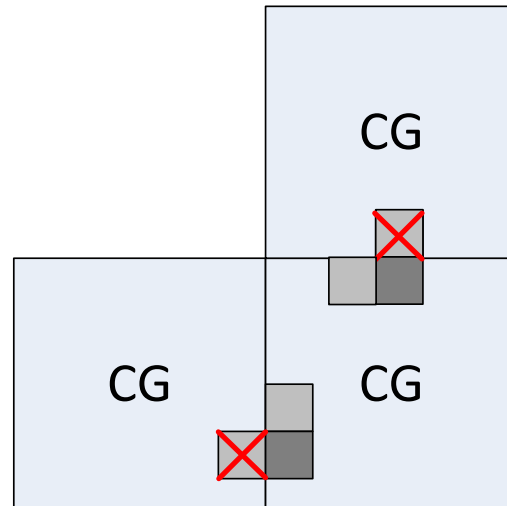
Proposed



JVET-M0057

Proposal (part 2)

- Reconstruction during parsing simplification by removal of across CGs context dependencies in TS residual coding JVET-M0464.
 - ***sig_coeff_flag*** context
 - ***abs_remainder_coding*** template for Rice parameter derivation



Results (part 1)(VTM-4.0 anchor)

		Y	U	V	EncT	DecT
AI	Class F	-3.91%	-2.40%	-2.47%	92%	97%
	Class SCC	-5.98%	-3.37%	-3.38%	125%	111%
RA	Class F	-2.68%	-1.82%	-1.97%	98%	99%
	Class SCC	-3.57%	-1.36%	-1.29%	123%	113%
LB	Class F	-1.99%	-1.25%	-1.56%	94%	102%
	Class SCC	-2.73%	-1.64%	-1.59%	117%	117%

Proposed 2bin/sample

		Y	U	V	EncT	DecT
AI	Class F	-3.77%	-2.26%	-2.31%	138%	105%
	Class SCC	-5.83%	-3.24%	-3.25%	166%	125%
RA	Class F	-2.65%	-1.71%	-1.77%	123%	107%
	Class SCC	-3.54%	-1.23%	-1.13%	150%	127%
LB	Class F	-1.94%	-1.63%	-1.62%	107%	112%
	Class SCC	#VALUE!	#VALUE!	#VALUE!	#NUM!	#NUM!

CE8-5.1a

Results (part 2)(VTM-4.0 anchor)

		Y	U	V	EncT	DecT
AI	Class F	-4.04%	-2.46%	-2.62%	86%	93%
	Class SCC	-6.33%	-3.64%	-3.68%	114%	111%
RA	Class F	-2.92%	-1.97%	-1.96%	84%	99%
	Class SCC	-3.83%	-1.51%	-1.46%	112%	114%
LB	Class F	-2.09%	-2.12%	-2.28%	85%	100%
	Class SCC	-2.79%	-1.70%	-1.62%	113%	117%

Proposed 3bin/sample

		Y	U	V	EncT	DecT
AI	Class F	-3.94%	-2.38%	-2.59%	139%	105%
	Class SCC	-6.23%	-3.63%	-3.63%	166%	124%
RA	Class F	-2.80%	-1.82%	-1.96%	123%	106%
	Class SCC	-3.77%	-1.56%	-1.48%	150%	127%
LB	Class F	-2.02%	-0.99%	-1.72%	107%	113%
	Class SCC	#VALUE!	#VALUE!	#VALUE!	#NUM!	#NUM!

CE8-5.1b

Results (part 1,2)(VTM-4.0 anchor)

		Y	U	V	EncT	DecT
AI	Class F	-3.91%	-2.40%	-2.47%	92%	97%
	Class SCC	-5.98%	-3.37%	-3.38%	125%	111%
RA	Class F	-2.68%	-1.82%	-1.97%	98%	99%
	Class SCC	-3.57%	-1.36%	-1.29%	123%	113%
LB	Class F	-1.99%	-1.25%	-1.56%	94%	102%
	Class SCC	-2.73%	-1.64%	-1.59%	117%	117%

Part 1 (2bin/sample)

		Y	U	V	EncT	DecT
AI	Class F	-3.86%	-2.29%	-2.40%	88%	96%
	Class SCC	-5.93%	-3.29%	-3.33%	119%	112%
RA	Class F	-2.70%	-1.93%	-2.02%	85%	98%
	Class SCC	-3.47%	-1.25%	-1.17%	112%	113%
LB	Class F	-2.03%	-1.65%	-2.31%	85%	103%
	Class SCC	-2.66%	-1.50%	-1.46%	114%	115%

Part 2 (2bin/sample)

Results (part 1)(CE8-4.4a anchor)

		Y	U	V
AI	Class F	-1.39%	-1.03%	-1.14%
	Class SCC	-2.19%	-1.69%	-1.60%
RA	Class F	-0.97%	-0.85%	-1.07%
	Class SCC	-0.93%	-0.62%	-0.66%
LB	Class F	-0.61%	-0.51%	-0.22%
	Class SCC	-0.43%	-0.31%	-0.32%

Part 1 (2bin/sample)

Conclusion

- Quantized residual level BDPCM allows reconstruction during parsing.
- Eliminates sequential dependency in reconstruction domain.
- Can be implemented in the parser or post parsing step.

- Thanks Alibaba for crosschecking