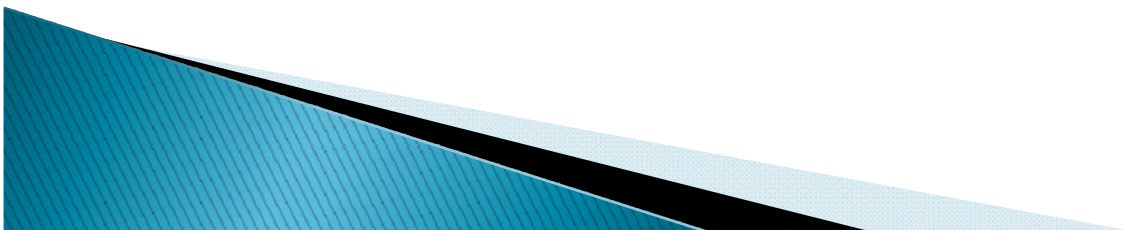


Refinement of SKIP Coding Mode for HEVC

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Introduction

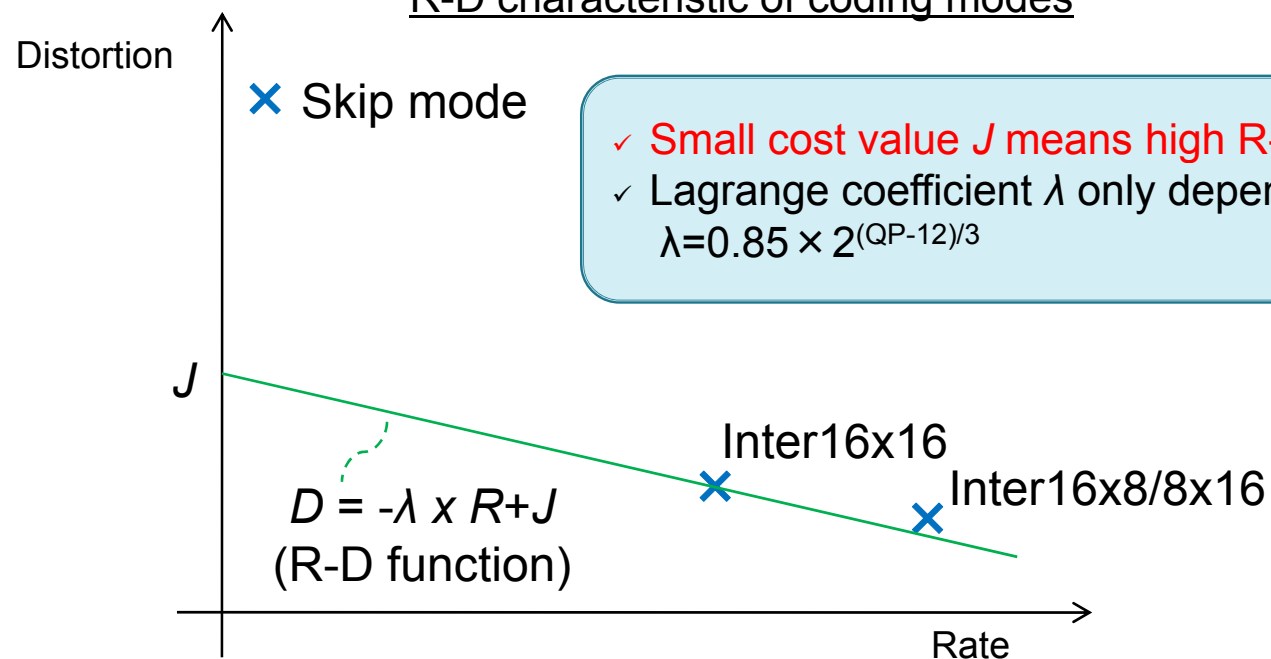
- ▶ About this contribution
 - Propose **an additional coding mode**
 - Extending H.264 SKIP mode
- ▶ Assumption
 - **High resolution video** and **low bit-rate condition**
 - Coding mode selection based on **R-D optimization criteria**
- ▶ Background
 - Difficult for H.264 to achieve optimal R-D performance
 - Appropriate coding mode is NOT defined
- ▶ Note
 - Basic idea was presented (VCEG-AL31, C328)



Coding Mode Selection

Rate - Distortion

R-D characteristic of coding modes



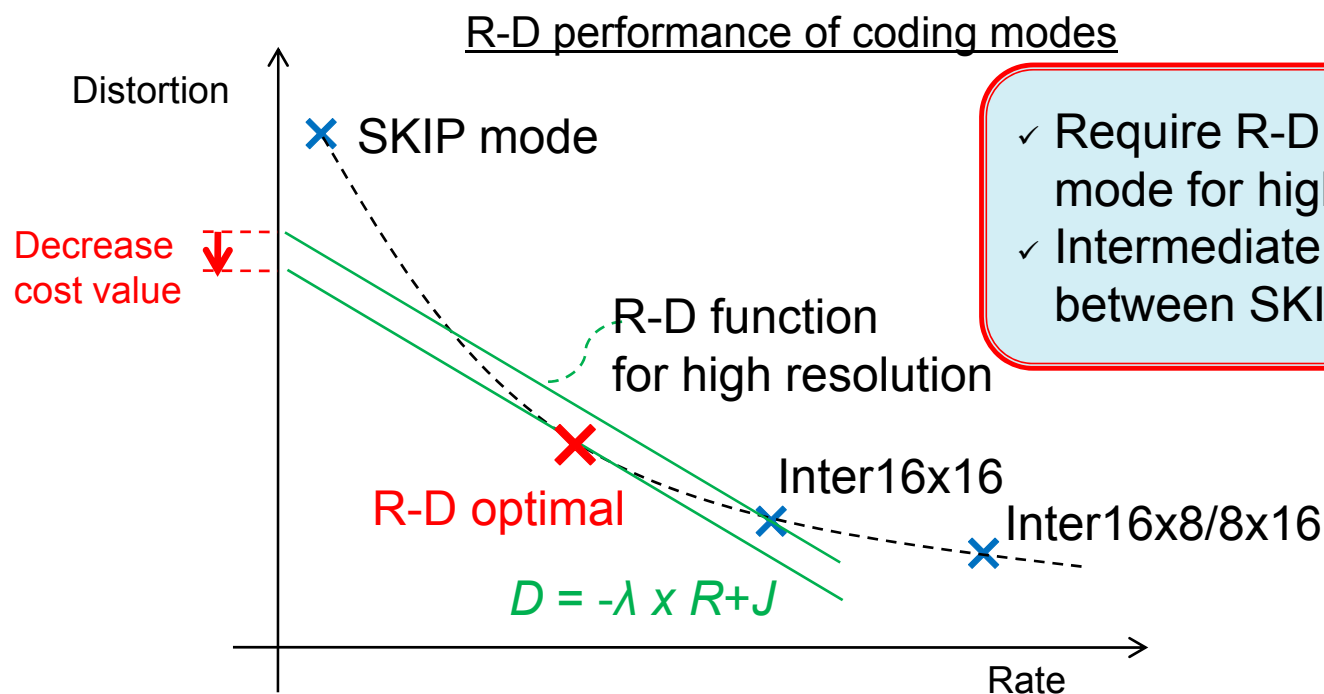
R-D cost function

$$J = D + \lambda \times R$$

J : cost, D : distortion, R : rate,
 λ : lagrange

High Resolution Video Coding

Rate - Distortion



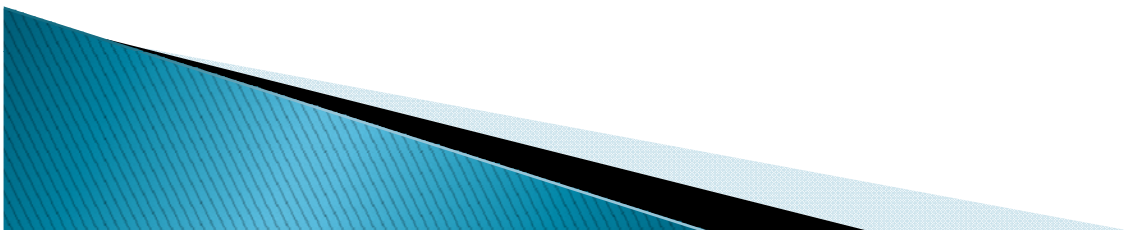
- ✓ Require R-D optimal coding mode for high resolution video
- ✓ Intermediate R-D characteristic between SKIP and Inter16x16

- Lagrange coefficient λ only depends on QP
 $\lambda = 0.85 \times 2^{(QP-12)/3}$
- Appropriate coding mode for R-D optimal point is not supported

New Coding Mode for P-picture

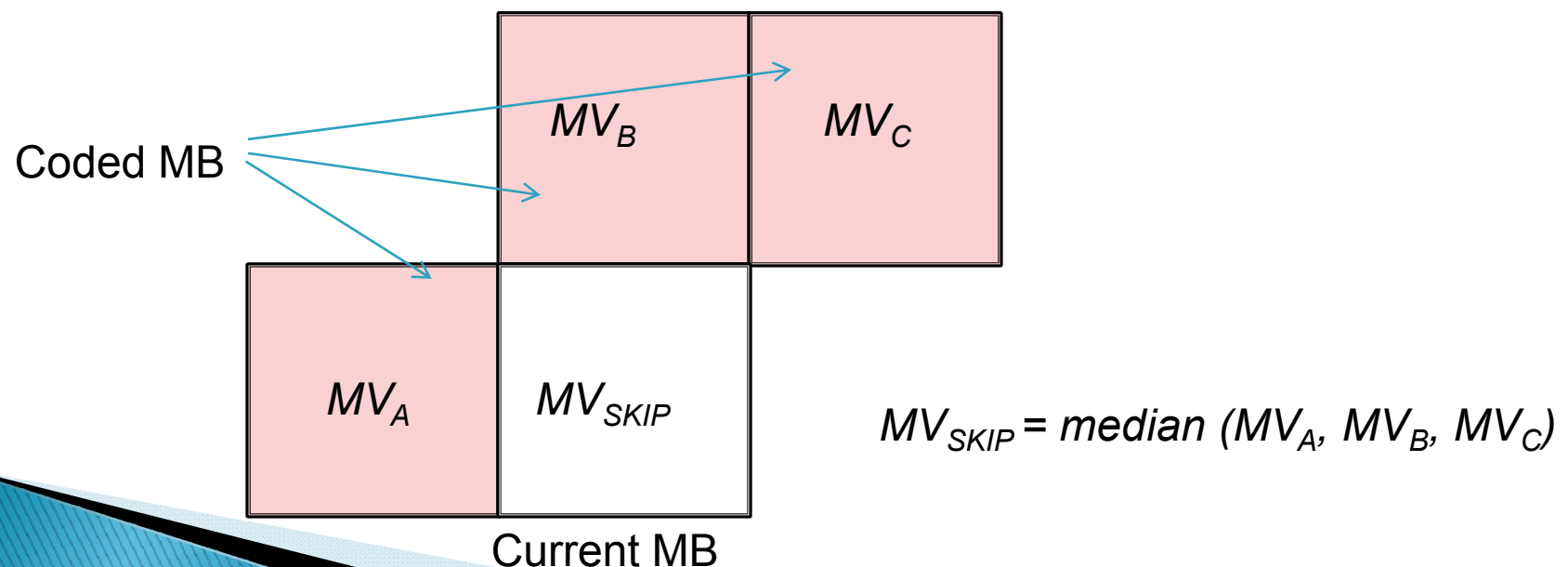
- ▶ Concept :
 - Intermediate R-D characteristics between SKIP and Inter16x16

- ▶ Proposal : SKIP with residual signal
 - Motion Vector (MV) information is NOT encoded
 - DCT coefficients of residual signal are encoded
 - Additional mb_type identifier for P-picture



MV Generation

- ▶ Predict MV from neighboring MBs based on median prediction
- ▶ Predicted MV is directly adopted as the new coding mode's MV
- ▶ Any MV information isn't encoded.

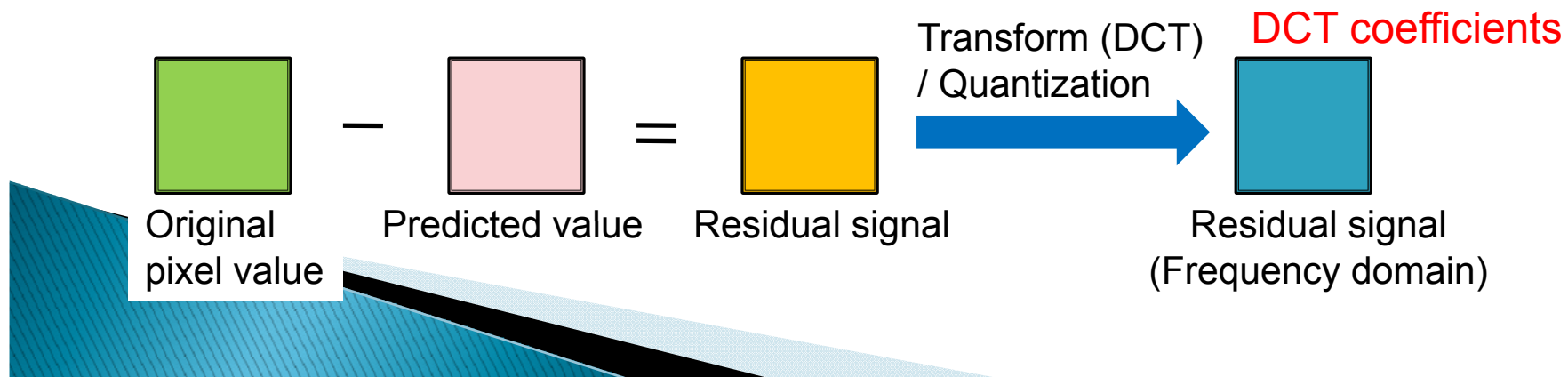


Residual Signal

► Encoding residual signal

- Same as H.264 Inter16x16 mode
 - Calculate the residual between original and predicted values
 - Transform the residual signal to frequency (DCT) domain
 - Encode the quantized DCT coefficients
- Note
 - Only DCT8x8 available -> Transform8x8 flag is not encoded.
 - Coded Block Pattern (CBP) available

Transform process to frequency domain



Control Information

- ▶ mb_type identifier
 - Define additional mb_type value for P-picture
 - Modify intra coding mode mb_type

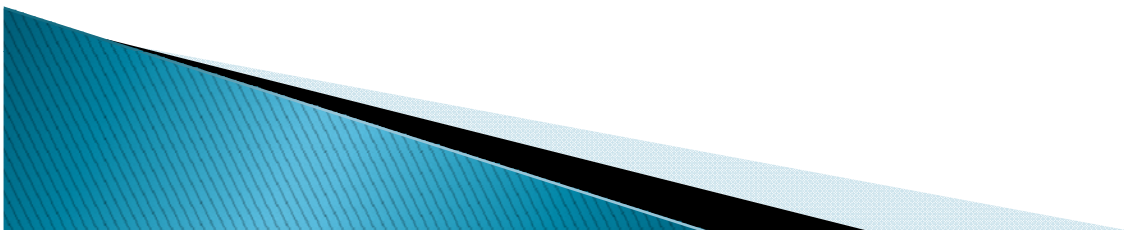
Table : Binarization for macroblock types in P slice

Value of mb_type	Binary string		
0 (P_L0_16x16)	0	0	0
1 (P_L0_L0_16x8)	0	1	1
2 (P_L0_L0_8x16)	0	1	0
3 (P_8x8)	0	0	1
4 (P_8x8ref0)	Na		
5 (New coding mode)	1	0	
6 to 30 (Intra, prefix only)	1	1	

Coding Conditions

- ▶ Coding condition : N11113
 - CS2 (IpPp)
- ▶ Software : Implemented on JM17.0
- ▶ Evaluation : VCEG-AI11 (BD-bitrate, BD-PSNR)

- ▶ Encoding residual signal with adaptive truncation
 - Divided into the lower/higher coefficients
 - Encode the lower, but NOT encode the higher
 - Decided based on R-D optimization



Experimental result

Class	Sequence	BD-bitrate[%]	BD-PSNR[dB]
B1 (1080p)	Kimono	-5.14	0.19
	ParkScene	-1.93	0.07
B2 (1080p)	Cactus	-2.38	0.07
	BasketBallDrive	-2.18	0.07
	BQTerrace	-6.88	0.15
C (WVGA)	BasketBallDrill	-2.23	0.09
	BQMall	-1.72	0.08
	PartyScene	-0.81	0.03
	RaceHorses	-0.90	0.04
D (WQVGA)	BasketBallPass	-0.59	0.03
	BQSquare	-0.10	0.00
	BlowingBubbles	-0.12	0.01
	RaceHorses	-0.64	0.03
E (720p)	Vidyo1	-3.78	0.16
	Vidyo3	-2.90	0.12
	Vidyo4	-3.28	0.13
Average		-2.22	0.08

Experimental result (HD sequence)

Class	Sequence	BD-bitrate[%]	BD-PSNR[dB]
B1 (1080p)	Kimono	-5.14	0.19
	ParkScene	-1.93	0.07
B2 (1080p)	Cactus	-2.38	0.07
	BasketBallDrive	-2.18	0.07
	BQTerrace	-6.88	0.15
E (720p)	Vidyo1	-3.78	0.16
	Vidyo3	-2.90	0.12
	Vidyo4	-3.28	0.13
Average		-3.56	0.12

- ▶ Bit reduction ratio against JM :
 - 2.2% for all sequences
 - 3.6% for HD sequences

Experimental result (HD sequence) without adaptive truncation

BD-bitrate (CS2) [%]

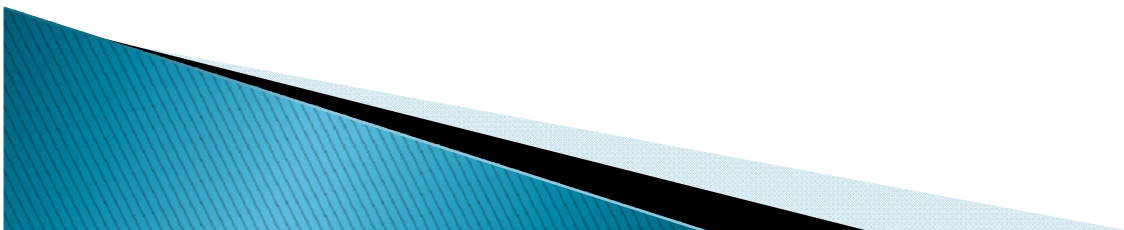
Class	Sequence	Without Adaptive Truncation	Adaptive Truncation
B1 (1080p)	Kimono	-2.99	-5.14
	ParkScene	-1.21	-1.93
B2 (1080p)	Cactus	-1.45	-2.38
	BasketBallDrive	-1.62	-2.18
	BQTerrace	-4.10	-6.88
E (720p)	Vidyo1	0.25	-3.78
	Vidyo3	-0.58	-2.90
	Vidyo4	-0.42	-3.28
Average		-1.52	-3.56

Encoding time increase ratio (Averaged for Class B and E)

- ▶ Without adaptive truncation : 0.4%
- ▶ With adaptive truncation : 27.8%

Conclusion

- ▶ Proposed **new coding mode** based on R-D characteristic analysis.
- ▶ Averaged bit saving ratio reached **2.2% for whole sequences** and **3.6% for HD sequences**.
- ▶ Very simple implementation
- ▶ Improve the coding performance



Thank you

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