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JCTVC-E133

Adaptive scaling for reference pictures memory compression

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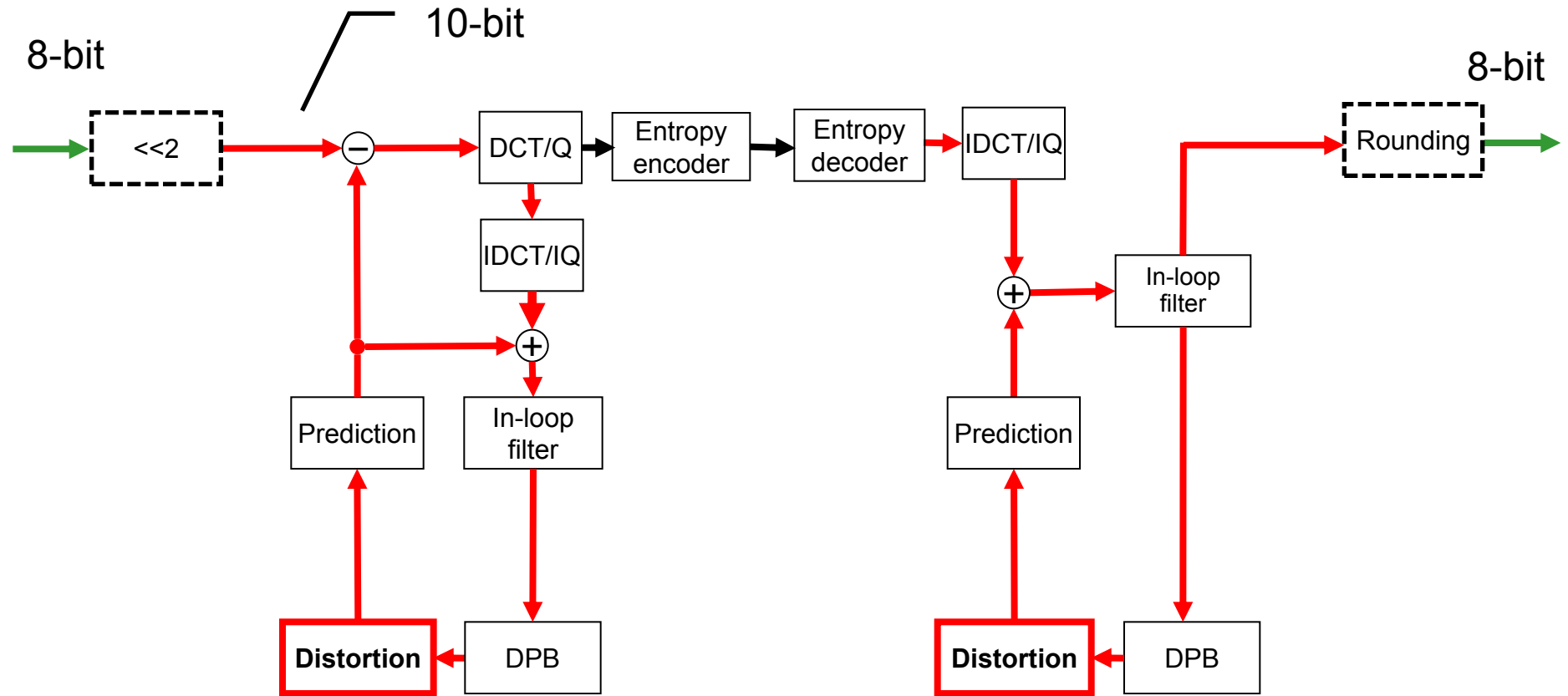
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Summary

- **Adhoc Group on reference pictures memory compression**
- **Adaptive scaling for reference pictures memory compression**
 - From 10-bit to 8-bit
 - Fixed length format by 4x4 block
 - Definition of compression distortion
- **Experimental results**
 - Loss is 0.71% compared to IBDI
 - Overhead of complexity is negligible.

Specification for standardization

- Internal 10-bit depth on HE anchor



Definition of compression distortion

Adaptive scaling

- **Dynamic range adaptive scaling**
- **Scaling process by 4x4 block**
- **Loss less compression on 8-bit depth level**
 - Results surely better than fixed scaling
- **Complexity is negligible**
- **Fixed length format**
- **Definition of compression distortion**

Definition of compression distortion

(1) Find min and max in 4x4 block

(2) Decide the scaling value S from difference between max and min.

```
for (S=0; max - (min & ~0x7)>=(128<<S) && S<2; S++);
```

(3) Control bit depth of pixels according to S.

```
if (S==2) {  
    D[0] = (pixel_value[0]<2)? 1: (pixel_value[0]+2) & ~0x3;  
    for (i=1;i<16;i++) D[i] = (pixel_value[i]+2) & ~0x3;  
} else if (S==0) {  
    for (i=0;i<16;i++) D[i] = pixel_value[i];  
} else {  
    for (i=0;i<16;i++) D[i] = (pixel_value[i] & ~0x1) + 1;  
}
```

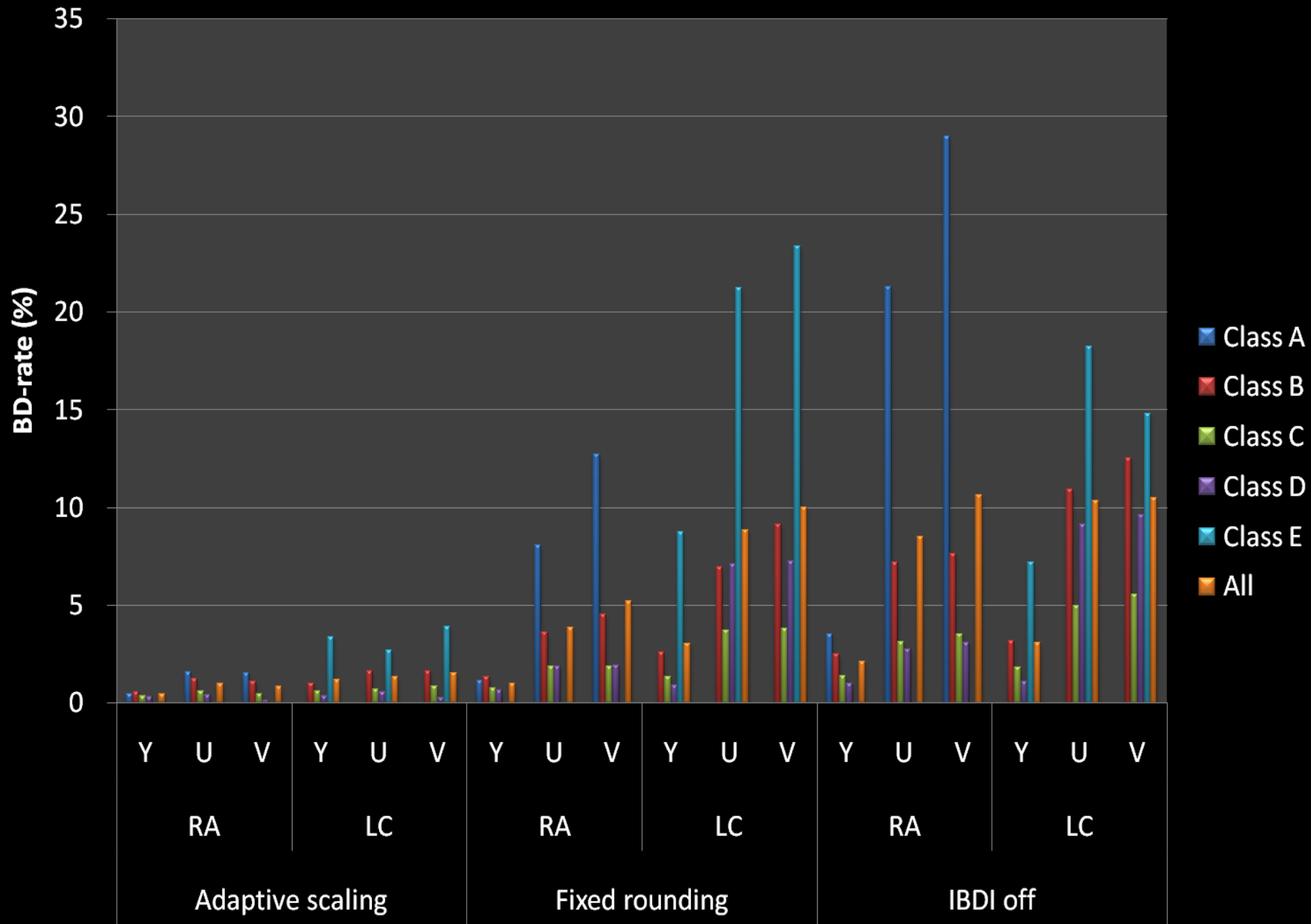
Test condition

- **Configurations are based on JCTVC-D600:**
 - Implementation on HM2.0 ahg-memory branch
 - 10-bit to 8-bit (high efficiency anchor)
 - High coding efficiency, random access configuration
 - High coding efficiency, low delay configuration
 - Common test condition is specified in JCTVC-D600
- **Evaluation criteria**
 - Measure impact on bitrate/PSNR using provided data. Use 4-point BD-PSNR and BD-Rate.
 - Memory compression ratio.
 - Memory access measures
 - Complexity (encoding and decoding times)

Experimental results (Summary)

	Random access			Low delay		
	Adaptive scaling	Fixed rounding	IBDI off	Adaptive scaling	Fixed rounding	IBDI off
Class A	0.48	1.12	3.50	N/A	N/A	N/A
Class B	0.57	1.33	2.48	1.02	2.57	3.16
Class C	0.36	0.78	1.40	0.62	1.34	1.81
Class D	0.31	0.63	0.99	0.34	0.92	1.08
Class E	N/A	N/A	N/A	3.37	8.73	7.17
Total	0.44	0.99	2.12	1.22	3.01	3.06

Adaptive(0.71) < Fixed(1.89) < IBDI off(2.87)



Complexity

- **Encoding and decoding time**

- Increase rate (%) of average encoding and decoding times

Proponent	Adaptive scaling		Fixed rounding		IBDI off	
Condition	Random access	Low delay	Random access	Low delay	Random access	Low delay
Encoding Time	100.35	99.98	101.23	100.89	99.80	99.80
Decoding Time	104.53	102.89	108.05	108.38	98.04	99.36

Not significantly increase

Memory access

- **Average motion compensation memory bandwidth saving rate (%)**
 - Both Luma and Chroma block size define 4x4
 - Rate defines 0.800

	8bit/ 8bit	32bit/ 64bit	32bit/ 128bit	64bit/ 128bit	64bit/ 256bit	64bit/ 512bit	64bit/ 256bit FIFO	64bit/ 512bit FIFO
RA	7.95	-7.74	-19.08	-23.54	-29.70	-46.77	-35.31	-39.70
LD	9.47	-7.16	-19.34	-23.98	-31.68	-50.47	-39.18	-44.23

Conclusion

- **Adaptive scaling for frame compression**
 - That loss is always smaller than loss of fixed rounding
 - Increase of complexity is negligible
- **Cross-checked by JCTVC-E187 (NEC)**
- **This is one of the solution of bit-depth compression of DPB on high efficiency anchor**

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