

Rounding-error conscious memory compression method for IBDI (JCTVC-D045/ M18792)

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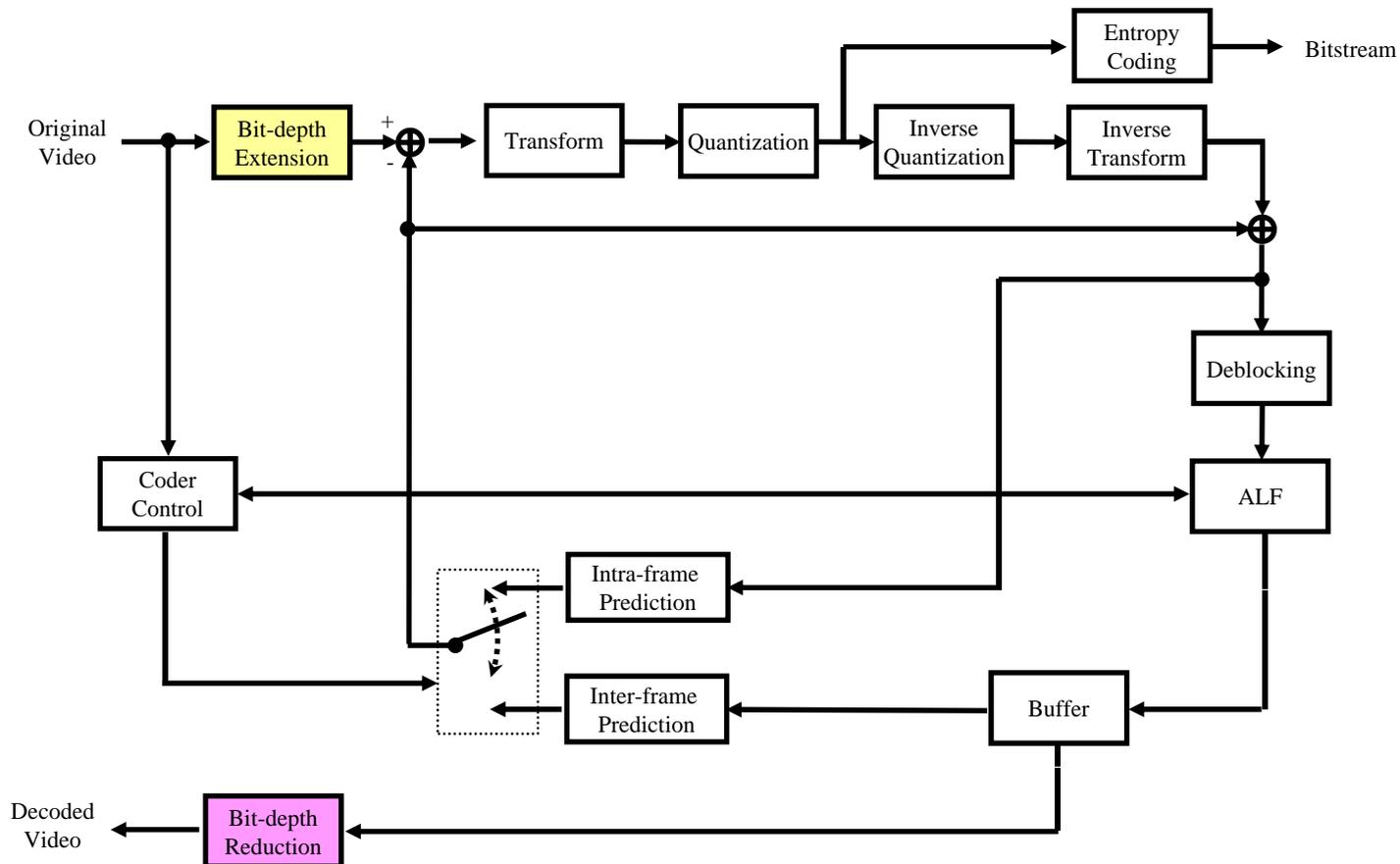
Summary

- Sum of Squared Errors (SSE) computation in TMuC
- Improved SSE computation for in-loop fixed rounding
- Simulation results against conventional in-loop fixed rounding
 - HE Random access: BD-rates -0.4%(Y), 0.2%(U), and -0.2%(V)
 - HE Low delay: -3.8%(Y), -0.9%(U), and -2.5%(V)
- Recommendations
 - In-loop fixed rounding is considered as one of the operation points of HEVC codec when IBDI is used
 - In-loop fixed rounding is used in a potential core experiments on reference picture memory compression technologies

Encoder block diagram w/o in-loop rounding

- SSE values for mode decision, ALF on/off decision, etc are

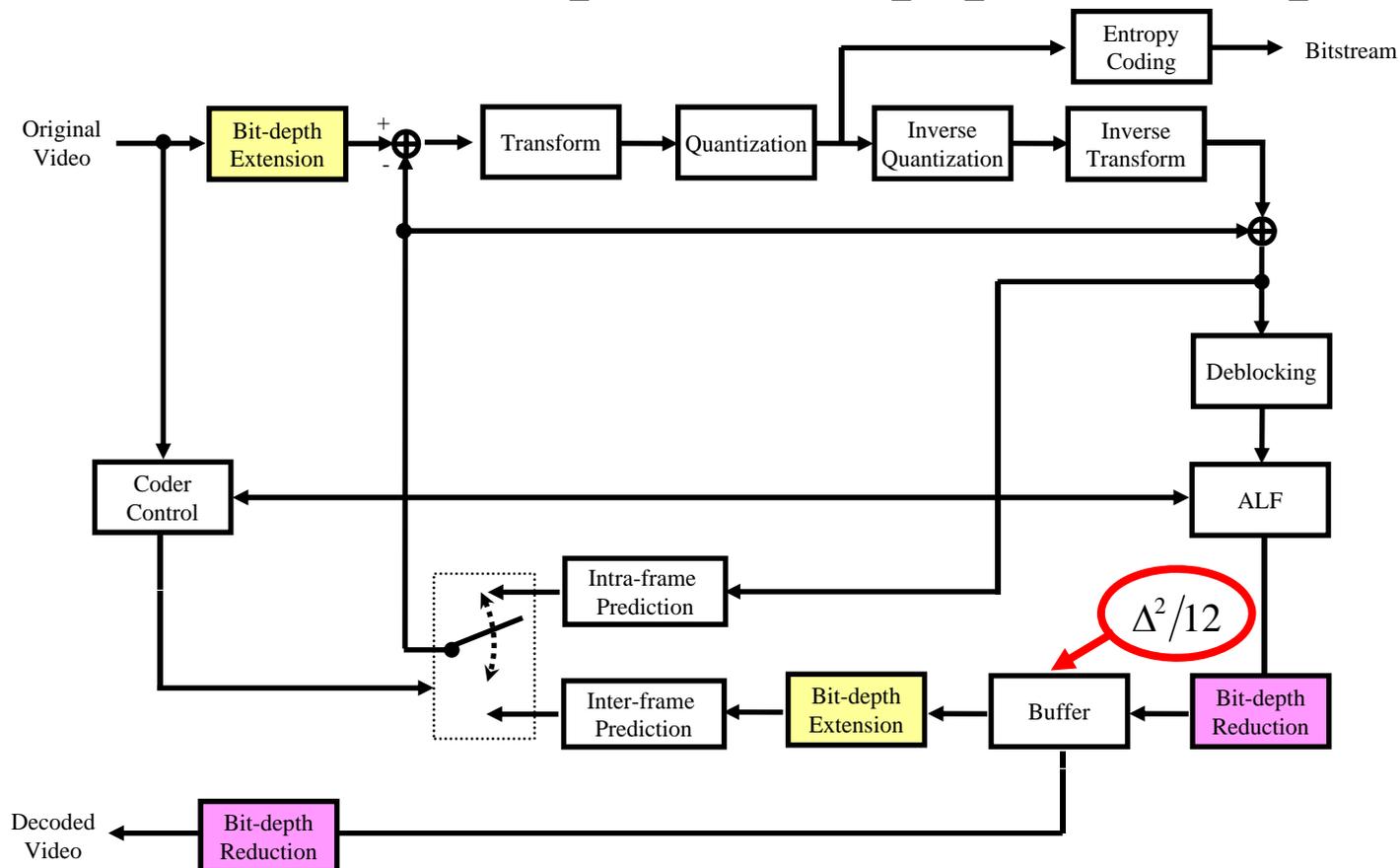
derived by
$$SSE(src, rec, \Delta) = \sum \sum (src[i, j] - rec[i, j]) / \Delta)^2$$



Encoder block diagram with in-loop rounding

- SSE values must be computed in a rounding-error conscious way as

$$SSE(src, rec, \Delta) = \sum \sum \left(\left\lfloor \frac{src[i, j]}{\Delta} + 0.5 \right\rfloor - \left\lfloor \frac{rec[i, j]}{\Delta} + 0.5 \right\rfloor \right)^2$$



Simulation

- Coding conditions base on JCTVC-C500
 - Fixed-Rounding: In-loop fixed rounding (with TMuC0.9 SSE computation)
 - IBDI-Off: High efficiency setting w/o IBDI
 - Proposal: In-loop fixed rounding with proposed SSE computation
- Computing platform
 - Windows 7 64-bit on Xeon 3.33GHz and Mem. 32GB

Results are cross-checked by Toshiba [JCTVC-D156]

Results

- Anomalous coding efficiency loss by in-loop rounding is avoided by Proposal
- Proposal performs better than IBDI-Off

	Fixed-Rounding RA			IBDI-Off RA			Proposal RA		
	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate
Class A	1.29	1.76	1.93	1.47	4.29	5.05	0.89	1.37	1.22
Class B	1.61	2.34	2.72	2.13	9.60	12.33	1.04	2.22	1.44
Class C	1.05	1.13	1.08	1.28	4.29	4.52	0.73	1.32	1.23
Class D	0.63	0.56	0.38	0.96	5.67	6.96	0.51	1.48	1.47
Class E									
All	1.15	1.46	1.55	1.50	6.43	7.85	0.80	1.67	1.36
Enc Time[%]	101%			100%			101%		
Dec Time[%]	113%			99%			102%		
	Fixed-Rounding LD			IBDI-Off LD			Proposal LD		
	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate
Class A									
Class B	4.09	3.18	4.22	3.54	12.25	15.11	2.08	3.67	4.61
Class C	2.45	3.24	3.06	2.40	7.55	8.02	1.48	2.86	2.86
Class D	1.56	8.69	9.37	1.61	14.17	14.51	0.89	9.12	9.79
Class E	27.07	6.52	15.14	11.38	8.12	9.67	8.21	0.09	-1.02
All	7.36	5.20	7.26	4.25	10.78	12.17	2.78	4.16	4.41
Enc Time[%]	104%			100%			102%		
Dec Time[%]	125%			99%			102%		

Conclusions and recommendations

Conclusions

- Modification of SSE computation solves the issue of in-loop fixed rounding
- In-loop fixed rounding is useful for reducing reference picture storage when IBDI is used

Recommendations

- In-loop fixed rounding is considered as one of the operation points of HEVC codec when IBDI is used
- In-loop fixed rounding is used in a potential core experiments on reference picture memory compression technologies

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