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VCEG-AI20

Bidirectional Prediction for Stored B-Slice

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Summary

- **Bug fix for stored B-slices**

- Introduction of
 - A new bidirectional prediction formula
- No-change of the other specifications except bidirectional prediction for stored B-slice

- **Experimental results**

- Average of 1.39% and up to 5.00% gain for hierarchical B structure
- Complexity increase is negligible.

Background

- **Rounding error of interpolation filter**
 - KTA1.9 has introduced the high-precision interpolation filter
 - The performance of interpolation filter has been improved
- **Rounding error of bidirectional prediction**

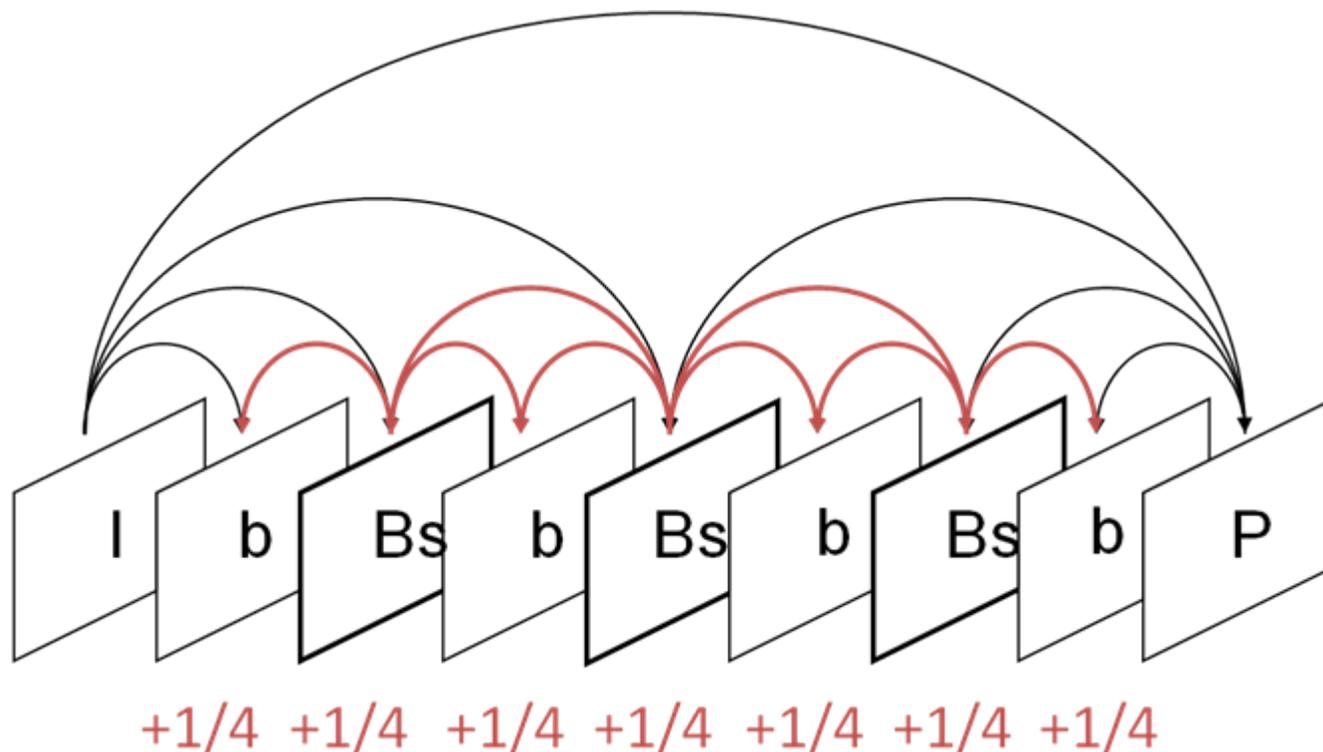
$$\text{Pred} = (\text{MC0} + \text{MC1} + 1) \gg 1 \quad E[\text{re}] = +1/4$$

$$\text{Pred} = (\text{MC0} + \text{MC1}) \gg 1 \quad E[\text{re}] = -1/4$$

- **The idea of VCEG-AI33(Qualcomm) is the same as ours**

Rounding Error Propagation

- Temporal propagation of rounding error of bidirectional prediction.

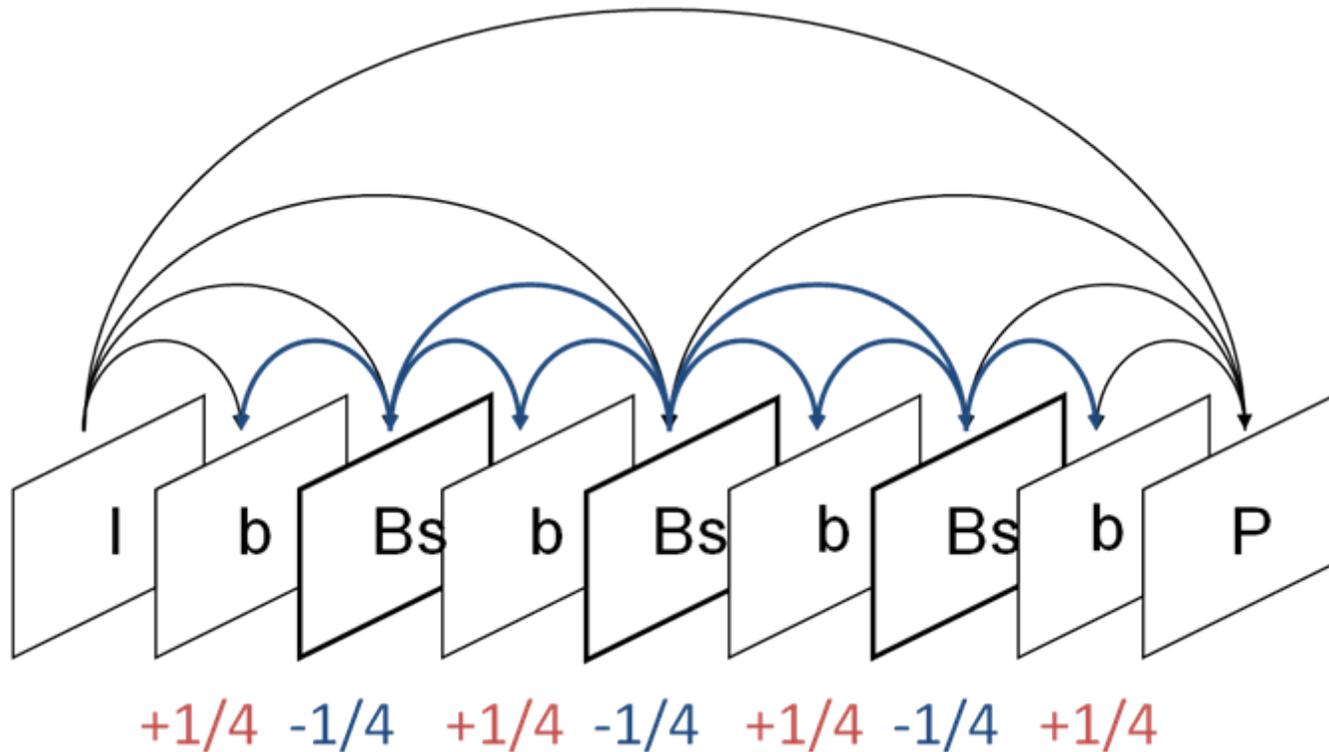


Proposal

- **Bidirectional prediction formula**

$\text{Pred} = (\text{MC0} + \text{MC1} + 1) \gg 1$ for Non-Stored B-Slice

$\text{Pred} = (\text{MC0} + \text{MC1}) \gg 1$ for Stored B-Slice



Balancing rounding up and down

Test Condition

- **New bidirectional prediction for stored B-slice**
- **The encoder configurations are as follows:**
 - KTA software version 1.9 (jm11.0kta1.9r1)
 - Hierarchical B structure based on VCEG-AE10r1
 - Hierarchical B structure based on VCEG-AE10r1 + HP + NewDC
- **PSNR gain (Δ PSNR) and bitrate saving (Δ Bitrate) are calculated based on BD-SNR (VCEG-M33) using BJM add-in supplied in VCEG-AE07.**

Experimental Results

Test sequences	HB on KTA1.9		HB on KTA1.9+HP+NewDC	
	Δ Bitrate (%)	Δ PSNR(dB)	Δ Bitrate (%)	Δ PSNR(dB)
container_qcif	1.17	0.057	0.64	0.038
foreman_qcif	0.30	0.018	-0.30	-0.017
silent_qcif	0.35	0.022	0.13	0.005
paris_cif	0.94	0.040	0.18	0.008
foreman_cif	0.83	0.037	0.28	0.013
mobile_cif	0.07	0.003	-0.03	-0.001
tempete_cif	1.01	0.040	0.60	0.023
Total average of QCIF & CIF	0.67	0.031	0.21	0.010
BigShips	5.00	0.131	1.57	0.041
City	2.72	0.118	1.25	0.041
Crew	0.73	0.017	1.62	0.038
Night	0.87	0.031	0.52	0.018
ShuttleStart	2.68	0.089	1.76	0.057
Total average of 720p	2.40	0.077	1.34	0.039
Total average	1.39	0.050	0.68	0.022

Experimental Results (Chroma)

Test Sequence	HB on KTA1.9				HB on KTA1.9+HP+NewDC			
	Cb		Cr		Cb		Cr	
	Δ Bitrate (%)	Δ PSNR (dB)	Δ Bitrate (%)	Δ PSNR (dB)	Δ Bitrate (%)	Δ PSNR (dB)	Δ Bitrate (%)	Δ PSNR (dB)
container_qcif	4.74	0.152	2.71	0.102	4.74	0.152	4.87	0.162
foreman_qcif	3.10	0.084	2.22	0.077	1.32	0.038	0.52	-0.004
silent_qcif	1.41	0.041	1.59	0.076	0.38	0.022	0.87	0.046
foreman_cif	3.68	0.081	3.98	0.109	2.44	0.055	3.52	0.098
mobile_cif	1.33	0.037	1.00	0.027	1.93	0.056	1.78	0.053
paris_cif	-0.35	-0.013	0.57	0.024	-0.19	-0.004	0.51	0.014
tempete_cif	4.27	0.092	4.91	0.084	3.68	0.086	5.05	0.096
Average of QCIF and CIF	2.60	0.068	2.42	0.071	2.04	0.058	2.44	0.066
BigShips	12.42	0.204	16.32	0.233	11.54	0.185	14.83	0.208
City	16.15	0.285	13.57	0.243	13.96	0.246	14.32	0.244
Crew	11.61	0.194	3.84	0.094	10.40	0.175	3.37	0.078
Night	3.14	0.077	4.68	0.114	2.39	0.059	4.13	0.100
ShuttleStart	15.77	0.534	-3.43	-0.090	15.18	0.508	-3.07	-0.084
Average of 720p	11.82	0.259	7.00	0.119	10.69	0.234	6.71	0.109
Average of all sequence	6.44	0.147	4.33	0.091	5.65	0.131	4.22	0.084

Other 720p sequences

Test Sequence	HB on KTA1.9		HB on KTA1.9+HP+NewDC	
	Δ Bitrate (%)	Δ PSNR (dB)	Δ Bitrate (%)	Δ PSNR (dB)
Cyclists	5.95	0.165	0.45	0.013
Harbour	1.77	0.062	0.53	0.018
Jets	4.68	0.148	0.80	0.013
Optis	3.71	0.091	1.26	0.031
Panslow	6.37	0.126	2.61	0.058
preakness	1.18	0.039	0.41	0.013
Raven	4.61	0.178	1.06	0.043
Sailormen	2.21	0.057	0.68	0.015
Spincalendar	3.43	0.099	0.82	0.029
Total average	3.77	0.107	0.96	0.026

1080p sequences

Test Sequence	HB on KTA1.9		HB on KTA1.9+HP+NewDC	
	Δ Bitrate (%)	Δ PSNR (dB)	Δ Bitrate (%)	Δ PSNR (dB)
Capitol_Records	1.35	0.050	0.49	0.019
Playing_Cards	1.25	0.050	0.51	0.014
Table_Setting	1.59	0.052	1.06	0.035
Freeway	1.01	0.039	0.55	0.021
Night	1.59	0.054	1.41	0.047
Plane	5.76	0.172	0.19	-0.017
Rolling_Tomatoes	0.94	0.025	0.89	0.021
Staples	1.07	0.031	1.24	0.035
Waves	1.10	0.039	1.50	0.053
toys_and_calendar	2.22	0.068	0.69	0.024
walking_couple	1.29	0.034	0.67	0.021
vintage_car	4.55	0.092	1.63	0.034
CrowdRun	0.68	0.028	0.27	0.011
DuckTakeOff	0.40	0.012	0.32	0.010
IntotheTrees	2.40	0.048	1.36	0.026
OldTownCross	3.31	0.084	1.18	0.024
ParkJoy	0.39	0.017	0.10	0.004
Total average	1.82	0.053	0.96	0.026

Conclusion

- **Bidirectional prediction for stored B-Slice is proposed.**
 - This is a bug fix of rounding.
 - Balancing rounding up and down
 - Unnecessary to encode the slice repeatedly
- **Average of 1.39% and up to 5.00% improvement for hierarchical B structure on KTA1.9**

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