
JVET-Q0433

ENCODER ONLY: ON UNBALANCED LUMA/CHROMA GAINS FOR DEPENDENT QUANTIZATION

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History of Gains for Dependent Quantization (AHG 13)

AHG13 tool-off test	All Intra			Random Access			Low Delay B		
	Y	Cb	Cr	Y	Cb	Cr	Y	Cb	Cr
VTM-2.0 (vs SDH=0)	2.44%	2.03%	1.75%	2.18%	1.20%	0.82%	1.82%	1.70%	0.88%
VTM-3.0	1.91%	1.15%	0.86%	1.66%	0.51%	0.06%	1.48%	0.86%	-0.31%
VTM-4.0	1.84%	1.04%	0.73%	1.57%	0.78%	0.25%	1.33%	1.47%	0.57%
VTM-5.0	1.90%	-0.94%	-0.95%	1.71%	-0.51%	-0.72%	1.37%	1.78%	1.42%
VTM-6.0	2.03%	-0.84%	-0.91%	1.76%	-0.24%	-0.61%	1.33%	1.49%	1.45%
VTM-7.0	1.99%	-0.66%	-0.73%	1.76%	-0.25%	-0.52%	1.56%	0.29%	-0.05%

add. data for low QP

VTM-6.0 (low QP)	1.45%	2.66%	2.71%	2.52%	3.78%	3.10%	2.51%	5.75%	4.92%
VTM-7.0 (low QP)	1.45%	2.54%	2.55%	2.58%	2.40%	1.25%	3.01%	4.30%	3.25%

Proposed Encoder Modification

```
void
EncSlice::setUpLambda( Slice* slice, const double dLambda, int iQP)
{
    ...
    #if PROPOSED_ENCODER_MODIFICATION
        if( m_pcCfg->getDepQuantEnabledFlag() && iQP > 18 )
    #else
        if( m_pcCfg->getDepQuantEnabledFlag() && !( m_pcCfg->getLFNST() ) )
    #endif
    {
        tmpWeight *= ( m_pcCfg->getGOPSize() >= 8 ? pow( 2.0, 0.1/3.0 ) : pow( 2.0, 0.2/3.0 ) );
        // increase chroma weight for dependent quantization
        // (in order to reduce bit rate shift from chroma to luma)
    }
    ...
}
```

Yellow-marked part was added in VTM-5

Experimental Results: Summary (SDR)

CTC	Over VTM-7.0							Over VTM-7.0 with DQ=0, SDH=1						
	Y	U	V	YUVa	YUVb	EncT	DecT	Y	U	V	YUVa	YUVb	EncT	DecT
AI	0.26%	-1.96%	-1.85%	-0.17%	-0.17%	101%	99%	-1.69%	-1.30%	-1.13%	-1.62%	-1.59%	105%	94%
RA	0.16%	-1.24%	-1.21%	-0.14%	-0.12%	101%	98%	-1.57%	-0.98%	-0.69%	-1.40%	-1.42%	101%	97%
LB	0.00%	0.00%	0.00%	0.00%	0.00%	100%	99%	-1.53%	-0.28%	0.06%	-1.27%	-1.24%	101%	99%
LP	0.00%	0.00%	0.00%	0.00%	0.00%	100%	96%	-1.54%	-0.55%	0.03%	-1.31%	-1.29%	101%	98%

LowQP	Over VTM-7.0							Over VTM-7.0 with DQ=0, SDH=1						
	Y	U	V	YUVa	YUVb	EncT	DecT	Y	U	V	YUVa	YUVb	EncT	DecT
AI	0.00%	0.00%	0.00%	0.00%	0.00%	102%	99%	-1.42%	-2.47%	-2.48%	-1.67%	-1.63%	119%	89%
RA	0.02%	-0.06%	-0.06%	0.00%	0.00%	101%	98%	-2.49%	-2.35%	-1.08%	-2.35%	-2.33%	119%	91%
LB	-0.21%	0.71%	0.66%	-0.03%	-0.03%	101%	97%	-3.11%	-3.41%	-2.47%	-3.10%	-3.08%	116%	93%
LP	-0.21%	0.63%	0.60%	-0.05%	-0.04%	101%	98%	-2.80%	-3.80%	-2.64%	-2.91%	-2.88%	117%	93%

YUVa: weighted PSNR values ($(6*Y+Cb+Cr)/8$)

YUVb: weighted BD rates ($(8*Y+Cb+Cr)/10$) [used by AHG13]

Experimental Results: All Intra (CTC)

	Over VTM-7.0							Over VTM-7.0 with DQ=0, SDH=1						
	Y	U	V	YUVa	YUVb	EncT	DecT	Y	U	V	YUVa	YUVb	EncT	DecT
A1	0.31%	-2.14%	-1.65%	-0.28%	-0.13%	101%	100%	-2.18%	-1.24%	-0.97%	-1.92%	-1.96%	100%	91%
A2	0.51%	-2.19%	-2.17%	0.02%	-0.03%	101%	102%	-2.87%	-1.14%	-1.27%	-2.74%	-2.53%	103%	90%
B	0.20%	-2.16%	-2.18%	-0.22%	-0.27%	101%	97%	-1.51%	-1.13%	-0.94%	-1.42%	-1.42%	105%	92%
C	0.19%	-1.57%	-1.53%	-0.14%	-0.16%	101%	96%	-1.07%	-1.82%	-1.51%	-1.18%	-1.19%	111%	96%
E	0.16%	-1.71%	-1.63%	-0.23%	-0.21%	100%	102%	-1.12%	-1.11%	-0.97%	-1.10%	-1.11%	105%	99%
AVG	0.26%	-1.96%	-1.85%	-0.17%	-0.17%	101%	99%	-1.69%	-1.30%	-1.13%	-1.62%	-1.59%	105%	94%
D	0.18%	-1.60%	-1.52%	-0.13%	-0.17%	100%	100%	-1.12%	-1.65%	-1.45%	-1.20%	-1.20%	111%	101%
F	0.19%	-1.15%	-1.01%	-0.07%	-0.06%	101%	101%	-0.51%	-1.38%	-1.31%	-0.67%	-0.68%	106%	99%

YUVa: weighted PSNR values ($(6*Y+Cb+Cr)/8$)

YUVb: weighted BD rates ($(8*Y+Cb+Cr)/10$) [used by AHG13]

Experimental Results: Random Access (CTC)

	Over VTM-7.0							Over VTM-7.0 with DQ=0, SDH=1						
	Y	U	V	YUVa	YUVb	EncT	DecT	Y	U	V	YUVa	YUVb	EncT	DecT
A1	0.25%	-1.24%	-1.01%	-0.16%	-0.03%	100%	97%	-1.66%	-0.77%	0.32%	-1.30%	-1.37%	98%	97%
A2	0.26%	-1.32%	-1.25%	-0.08%	-0.05%	102%	96%	-1.70%	-0.87%	-0.94%	-1.51%	-1.54%	102%	99%
B	0.11%	-1.32%	-1.40%	-0.18%	-0.19%	100%	99%	-1.80%	-0.56%	-0.52%	-1.56%	-1.55%	100%	96%
C	0.09%	-1.07%	-1.09%	-0.14%	-0.14%	100%	99%	-1.11%	-1.73%	-1.48%	-1.20%	-1.21%	104%	98%
AVG	0.16%	-1.24%	-1.21%	-0.14%	-0.12%	101%	98%	-1.57%	-0.98%	-0.69%	-1.40%	-1.42%	101%	97%
D	0.07%	-1.27%	-1.17%	-0.18%	-0.19%	101%	103%	-1.23%	-1.72%	-1.26%	-1.28%	-1.28%	104%	98%
F	0.09%	-0.59%	-0.78%	-0.08%	-0.07%	100%	100%	-0.61%	-1.71%	-1.76%	-0.85%	-0.84%	103%	98%

YUVa: weighted PSNR values ($(6*Y+Cb+Cr)/8$)

YUVb: weighted BD rates ($(8*Y+Cb+Cr)/10$) [used by AHG13]

Experimental Results: HDR vs VTM-7.0 (CTC: DQ=1)

All Intra													
		wPSNR						PSNR					
DE100 'SNR-L10		Y	U	V	YUVa	YUVb	Y	U	V	YUVa	YUVb	EncT	DecT
H1	-1.71% 0.24%	0.24%	-3.33%	-4.34%	-0.14%	-0.57%	0.24%	-3.51%	-4.66%	-0.16%	-0.63%	101%	98%
H2							0.16%	-1.79%	-2.11%	-0.11%	-0.26%	100%	103%
AVG	-1.71% 0.24%	0.24%	-3.33%	-4.34%	-0.14%	-0.57%	0.21%	-2.88%	-3.73%	-0.14%	-0.49%	101%	100%

Random Access													
		wPSNR						PSNR					
DE100 'SNR-L10		Y	U	V	YUVa	YUVb	Y	U	V	YUVa	YUVb	EncT	DecT
H1	-0.95% 0.11%	0.11%	-2.12%	-2.43%	-0.15%	-0.37%	0.10%	-2.25%	-2.56%	-0.16%	-0.40%	101%	99%
H2							0.06%	-1.53%	-1.67%	-0.16%	-0.27%	101%	100%
AVG	-0.95% 0.11%	0.11%	-2.12%	-2.43%	-0.15%	-0.37%	0.09%	-1.99%	-2.24%	-0.16%	-0.35%	101%	99%

YUVa: weighted (w)PSNR values ($(6*Y+Cb+Cr)/8$)

YUVb: weighted BD rates ($(8*Y+Cb+Cr)/10$) [used by AHG13]

Experimental Results: HDR vs VTM-7.0 (DQ=0, SDH=1)

	All Intra													
	DE100 'SNR-L10		wPSNR					PSNR					EncT DecT	
			Y	U	V	YUVa	YUVb	Y	U	V	YUVa	YUVb		
H1	-0.05%	-1.34%	-1.43%	-0.11%	0.08%	-1.29%	-1.15%	-1.39%	-0.32%	-0.25%	-1.29%	-1.17%	104%	97%
H2								-1.65%	-0.50%	-0.67%	-1.54%	-1.44%	101%	98%
AVG	-0.05%	-1.34%	-1.43%	-0.11%	0.08%	-1.29%	-1.15%	-1.49%	-0.38%	-0.41%	-1.38%	-1.27%	103%	98%

	Random Access													
	DE100 'SNR-L10		wPSNR					PSNR					EncT DecT	
			Y	U	V	YUVa	YUVb	Y	U	V	YUVa	YUVb		
H1	0.68%	-1.44%	-1.42%	1.37%	1.92%	-1.10%	-0.80%	-1.36%	1.32%	1.72%	-1.07%	-0.79%	101%	98%
H2								-1.70%	-1.08%	-0.90%	-1.60%	-1.55%	99%	100%
AVG	0.68%	-1.44%	-1.42%	1.37%	1.92%	-1.10%	-0.80%	-1.48%	0.44%	0.77%	-1.26%	-1.07%	100%	98%

YUVa: weighted (w)PSNR values ($(6*Y+Cb+Cr)/8$)

YUVb: weighted BD rates ($(8*Y+Cb+Cr)/10$) [used by AHG13]

Summary

Suggested Encoder Modification

- Revert lambda setting for dep. quantization to original version (VTM-2)
- Yields better balanced luma/chroma gains
- Small gains for YUV metrics