

JVET-L0381

**CE3-related: 4-tap interpolation filter selection
with quantization parameter**

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Overview

■ Motivation

- Intra interpolation filters improves coding gain, so that they are studied in CE3.3.
- 4-tap Cubic/Gaussian filters selected by block-size are proposed by JVET-L0130 etc.
- More coding efficiency by this filter is required.

■ Proposed Method

- The block-size threshold switching C/G filters is changed by QP values.

■ Simulation Results

- BD-rate gain -0.40%/-0.15% in AI/RA is confirmed comparing VTM2.

Motivation

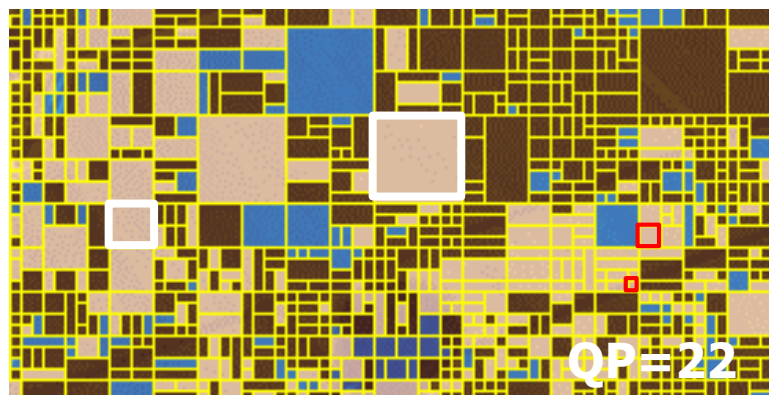
■ 4-tap C/G filters are switched by intra block-size threshold.

- Cubic applied: block size ≤ 64 samples (i.e. block length ≤ 8)
- Gaussian applied: block size > 64 samples (i.e. block length > 8)

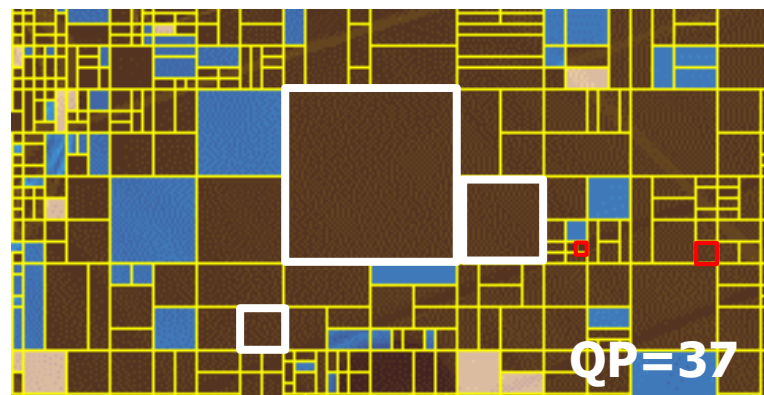
⇒ **The block-size threshold is fixed even if CU-QP value changes.**

■ The fixed-block-size threshold is not necessarily optimal.

- Here is the analysis to verify the optimal filter selections by removing the fixed-block-sized based selection but using RDO selection instead.



Gaussian is also applied for smaller blocks (≤ 64).



Cubic is also applied for larger blocks (> 64).

 :Cubic  :Gaussian  :None

Red frame: Block size ≤ 64 samples
White frame: Block size > 64 samples

Proposed Method

- The block size threshold is changed by QP values.

Block length→ ↓ QP values	BL≤4	BL=8	BL=16	BL=32	BL≥64
QP=17	Cubic	Gaussian	Gaussian	Gaussian	Gaussian
QP=18	Cubic	Cubic	Gaussian	Gaussian	Gaussian
QP=...	Cubic	Cubic	Gaussian	Gaussian	Gaussian
QP=24	Cubic	Cubic	Gaussian	Gaussian	Gaussian
QP=25	Cubic	Cubic	Cubic	Gaussian	Gaussian
QP=...	Cubic	Cubic	Cubic	Gaussian	Gaussian
QP=36	Cubic	Cubic	Cubic	Gaussian	Gaussian
QP=37	Cubic	Cubic	Cubic	Cubic	Gaussian

Fixed-threshold

Proposal

- We conducted three sets of QP range simulations to verify the effect.

- CTC-QP {22~37}, Low-QP {12~27}, High-QP {37~47}

Results

		All Intra Main10					Random Access Main10				
		Over VTM2					Over VTM2				
CTC-QP		Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
	Class A1	-0.03%	-0.13%	-0.14%	104%	100%	-0.07%	-0.22%	-0.11%	101%	101%
	Class A2	-0.16%	-0.25%	-0.34%	103%	101%	-0.06%	-0.30%	-0.33%	101%	100%
	Class B	-0.39%	-0.58%	-0.55%	103%	101%	-0.14%	-0.45%	-0.37%	101%	101%
	Class C	-0.68%	-1.03%	-0.96%	101%	101%	-0.24%	-0.30%	-0.35%	101%	100%
	Class E	-0.63%	-0.62%	-0.87%	102%	101%					
	Overall	-0.40%	-0.56%	-0.59%	103%	101%	-0.14%	-0.33%	-0.30%	101%	100%
High-QP	Class D	-0.50%	-0.56%	-0.90%	101%	100%	-0.23%	-0.69%	-0.22%	101%	100%
	Class A1	-0.07%	-0.09%	-0.15%	106%	99%	0.05%	-0.05%	0.02%	101%	101%
	Class A2	-0.04%	-0.12%	-0.11%	104%	99%	-0.05%	-0.15%	-0.11%	101%	100%
	Class B	-0.46%	-0.66%	-0.48%	104%	100%	-0.26%	-0.52%	-0.40%	102%	103%
	Class C	-0.63%	-0.56%	-1.01%	103%	103%	-0.26%	-0.84%	-0.13%	101%	105%
	Class E	-0.52%	-0.62%	-0.67%	103%	102%					
	Overall	-0.37%	-0.45%	-0.51%	104%	101%	-0.15%	-0.44%	-0.19%	101%	103%
Low-QP	Class D	-0.43%	-0.70%	-1.09%	103%	103%	-0.31%	-0.79%	-0.37%	101%	112%
	Class A1	-0.16%	-0.13%	-0.09%	104%	103%	-0.11%	-0.22%	-0.14%	102%	100%
	Class A2	-0.14%	-0.09%	-0.13%	103%	102%	-0.06%	-0.26%	-0.27%	101%	99%
	Class B	-0.33%	-0.27%	-0.28%	103%	101%	-0.09%	-0.26%	-0.37%	101%	100%
	Class C	-0.42%	-0.44%	-0.48%	100%	100%	-0.17%	-0.17%	-0.23%	101%	100%
	Class E	-0.41%	-0.43%	-0.45%	102%	101%					
	Overall	-0.30%	-0.28%	-0.30%	102%	101%	-0.11%	-0.23%	-0.26%	101%	100%
	Class D	-0.32%	-0.30%	-0.34%	100%	97%	-0.13%	-0.21%	-0.21%	101%	100%

Conclusion

■ Proposal Summary

- Block-sized and QP based filter selection is proposed.
- Conduct versatile QP range {QP = 12~47} simulation to verify the effects.

■ Simulation Results

- CTC-QP range: AI -0.40%, RA -0.14%
- High-QP range: AI -0.37%, RA -0.15%
- Low-QP range: AI -0.30%, RA -0.11%

■ Recommend to adopt future VTM or to further study in future CE3

Appendix: Comparing Fixed-block-size threshold 4-tap C/G filter

		All Intra Main10					Random Access Main10				
		Over VTM2+Fixed threshold 4-tap C/G filter					Over VTM2+Fixed threshold 4-tap C/G filter				
		Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
CTC-QP	Class A1	0.13%	-0.06%	-0.09%	100%	100%	0.07%	0.02%	0.03%	100%	101%
	Class A2	-0.03%	-0.10%	-0.17%	99%	100%	0.01%	0.00%	-0.06%	100%	100%
	Class B	-0.03%	-0.20%	-0.19%	99%	100%	0.02%	-0.11%	-0.12%	100%	101%
	Class C	-0.11%	-0.18%	-0.15%	99%	100%	0.01%	0.04%	0.18%	100%	100%
	Class E	-0.14%	-0.31%	-0.33%	99%	100%					
	Overall	-0.04%	-0.17%	-0.18%	99%	100%	0.02%	-0.02%	0.00%	100%	100%
	Class D	0.01%	-0.12%	-0.28%	100%	99%	0.01%	-0.03%	-0.01%	100%	100%
High-QP	Class A1	0.08%	-0.06%	-0.11%	101%	98%	0.07%	-0.02%	0.04%	100%	100%
	Class A2	0.03%	-0.01%	-0.06%	100%	98%	-0.04%	-0.08%	0.09%	100%	100%
	Class B	-0.25%	-0.59%	-0.55%	100%	99%	-0.07%	-0.35%	-0.32%	100%	101%
	Class C	-0.31%	-0.52%	-0.56%	100%	101%	-0.01%	-0.25%	0.17%	100%	100%
	Class E	-0.32%	-0.91%	-0.65%	99%	100%					
	Overall	-0.17%	-0.44%	-0.41%	100%	100%	-0.02%	-0.20%	-0.03%	100%	100%
	Class D	-0.10%	-0.53%	-0.53%	100%	104%	-0.12%	-0.22%	0.17%	100%	100%
Low-QP	Class A1	-0.05%	-0.04%	-0.02%	100%	103%	0.00%	0.06%	0.04%	100%	100%
	Class A2	-0.01%	0.05%	0.03%	100%	102%	0.00%	0.02%	0.03%	100%	100%
	Class B	-0.12%	-0.06%	-0.03%	100%	101%	-0.04%	-0.01%	-0.04%	100%	99%
	Class C	0.08%	0.07%	0.07%	98%	99%	0.00%	0.05%	0.07%	100%	100%
	Class E	0.10%	0.08%	0.06%	100%	101%					
	Overall	-0.01%	0.01%	0.02%	100%	101%	-0.01%	0.03%	0.02%	100%	100%
	Class D	0.09%	0.07%	0.08%	99%	98%	0.01%	0.02%	0.04%	100%	100%