

**JVET-L0381**

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

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# Overview

## ■ Motivation

- Intra reference sample interpolation filters improve coding gain (CE3.3).
- Switching 4-tap Cubic/Gaussian filters is promising.
- The current criteria like block size is not optimal since cutoff freq. is not considered.

## ■ Proposed Method

- Switching condition is combination of block size and QP value.
- C/G filters are identical to CE3-3.1.1 (JVET-L0130)

## ■ Simulation Results

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

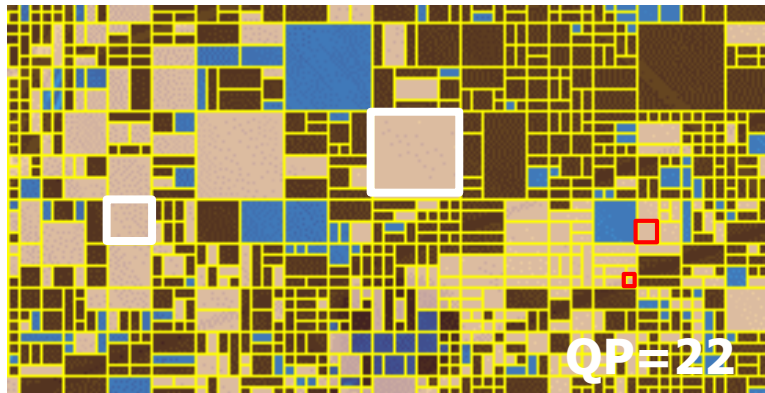
# Motivation

## ■ Switching criteria of 4-tap C/G filters is intra block-size.

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

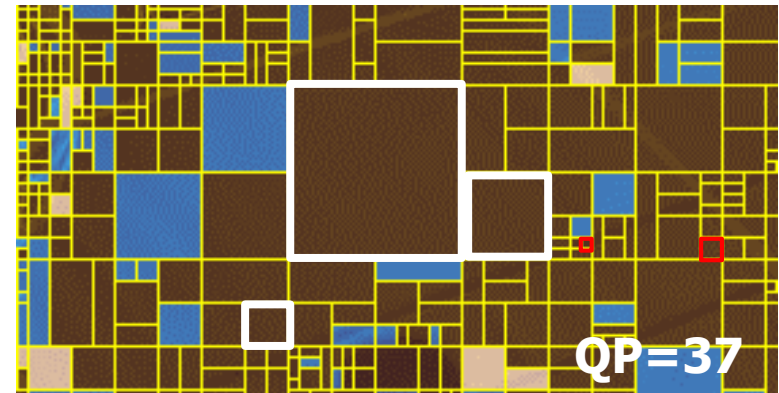
## ■ The block-size threshold is not optimal.

- Optimal filter selections by removing the block-sized criteria and by using RDO.
- Cutoff frequency is not considered in the current criteria.



Gaussian is also applied for smaller blocks ( $\leq 64$ ).

 :Cubic  :Gaussian  :None



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

Yellow line: CU boundary  
Red frame: Block size  $\leq 64$  samples  
White frame: Block size  $> 64$  samples

# Proposed Method

## ■ Criteria is combination of block size and QP value

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

Proposal

## ■ Three sets of QP range simulations are conducted.

- CTC-QP=22,27,32,37 Low-QP=12,17,22,27 High-QP=32,37,42,47

# 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%

# Additional results

## ■ Proposal is implemented on top of CE3-3.1.1 (JVET-L0130)

- Switching condition is combination of angular mode, block size, and QP value.
- No cross-check.

### CTC-QP (QP=22~37)

	All Intra Main10				
	Over VTM-2.0.1				
	Y	U	V	EncT	DecT
Class A1	-0.06%	-0.07%	-0.12%	102.2%	100.2%
Class A2	-0.17%	-0.15%	-0.18%	101.8%	100.4%
Class B	-0.43%	-0.43%	-0.48%	101.3%	100.6%
Class C	-0.76%	-0.93%	-0.93%	100.0%	100.6%
Class E	-0.73%	-0.80%	-0.79%	100.5%	100.4%
Overall	-0.45%	-0.50%	-0.52%	101.1%	100.5%
Class D	-0.55%	-0.32%	-0.61%	99.9%	100.0%

### High-QP (QP=32~47)

	AI Intra Main10				
	Over VTM-2.0.1				
	Y	U	V	EncT	DecT
Class A1	-0.08%	-0.08%	-0.01%	102.2%	100.0%
Class A2	-0.10%	-0.07%	-0.02%	101.6%	100.3%
Class B	-0.52%	-0.44%	-0.40%	101.1%	100.5%
Class C	-0.72%	-0.30%	-0.71%	100.9%	100.7%
Class E	-0.57%	-0.35%	-0.61%	100.8%	100.8%
Overall	-0.43%	-0.27%	-0.38%	101.3%	100.5%
Class D	-0.50%	-0.31%	-0.52%	100.4%	100.5%

# 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: Comparison with CE3.1.1 (JVET-L0130)

## ■ CE-3.1.1

### CTC-QP (QP=22~37)

	All Intra Main10				
	Over VTM-2				
	Y	U	V	EncT	DecT
Class A1	-0.18%	-0.16%	-0.15%	103.0%	100.1%
Class A2	-0.15%	-0.07%	-0.14%	102.6%	100.7%
Class B	-0.41%	-0.41%	-0.40%	102.8%	100.8%
Class C	-0.65%	-0.78%	-0.69%	101.1%	101.7%
Class E	-0.59%	-0.71%	-0.64%	101.7%	100.6%
Overall	-0.41%	-0.44%	-0.42%	102.2%	100.8%
Class D	-0.53%	-0.45%	-0.69%	101.0%	101.3%

### Hihg-QP (QP=32~47)

	AI Intra Main10				
	Over VTM-2				
	Y	U	V	EncT	DecT
Class A1	-0.18%	-0.16%	-0.16%	103.3%	100.3%
Class A2	-0.03%	-0.20%	-0.04%	103.4%	100.3%
Class B	-0.20%	-0.07%	0.02%	103.6%	100.7%
Class C	-0.37%	0.01%	-0.16%	102.8%	101.8%
Class E	-0.20%	0.02%	-0.18%	103.2%	101.2%
Overall	-0.20%	-0.08%	-0.09%	103.3%	100.9%
Class D	-0.40%	-0.46%	-0.62%	102.4%	101.3%

## ■ Proposal on top of CE-3.1.1

### CTC-QP (QP=22~37)

	All Intra Main10				
	Over VTM-2.0.1				
	Y	U	V	EncT	DecT
Class A1	-0.06%	-0.07%	-0.12%	102.2%	100.2%
Class A2	-0.17%	-0.15%	-0.18%	101.8%	100.4%
Class B	-0.43%	-0.43%	-0.48%	101.3%	100.6%
Class C	-0.76%	-0.93%	-0.93%	100.0%	100.6%
Class E	-0.73%	-0.80%	-0.79%	100.5%	100.4%
Overall	-0.45%	-0.50%	-0.52%	101.1%	100.5%
Class D	-0.55%	-0.32%	-0.61%	99.9%	100.0%

### Hihg-QP (QP=32~47)

	AI Intra Main10				
	Over VTM-2.0.1				
	Y	U	V	EncT	DecT
Class A1	-0.08%	-0.08%	-0.01%	102.2%	100.0%
Class A2	-0.10%	-0.07%	-0.02%	101.6%	100.3%
Class B	-0.52%	-0.44%	-0.40%	101.1%	100.5%
Class C	-0.72%	-0.30%	-0.71%	100.9%	100.7%
Class E	-0.57%	-0.35%	-0.61%	100.8%	100.8%
Overall	-0.43%	-0.27%	-0.38%	101.3%	100.5%
Class D	-0.50%	-0.31%	-0.52%	100.4%	100.5%