JVET-O0914
CE8-related: Improved Color Generation Method for Palette Mode

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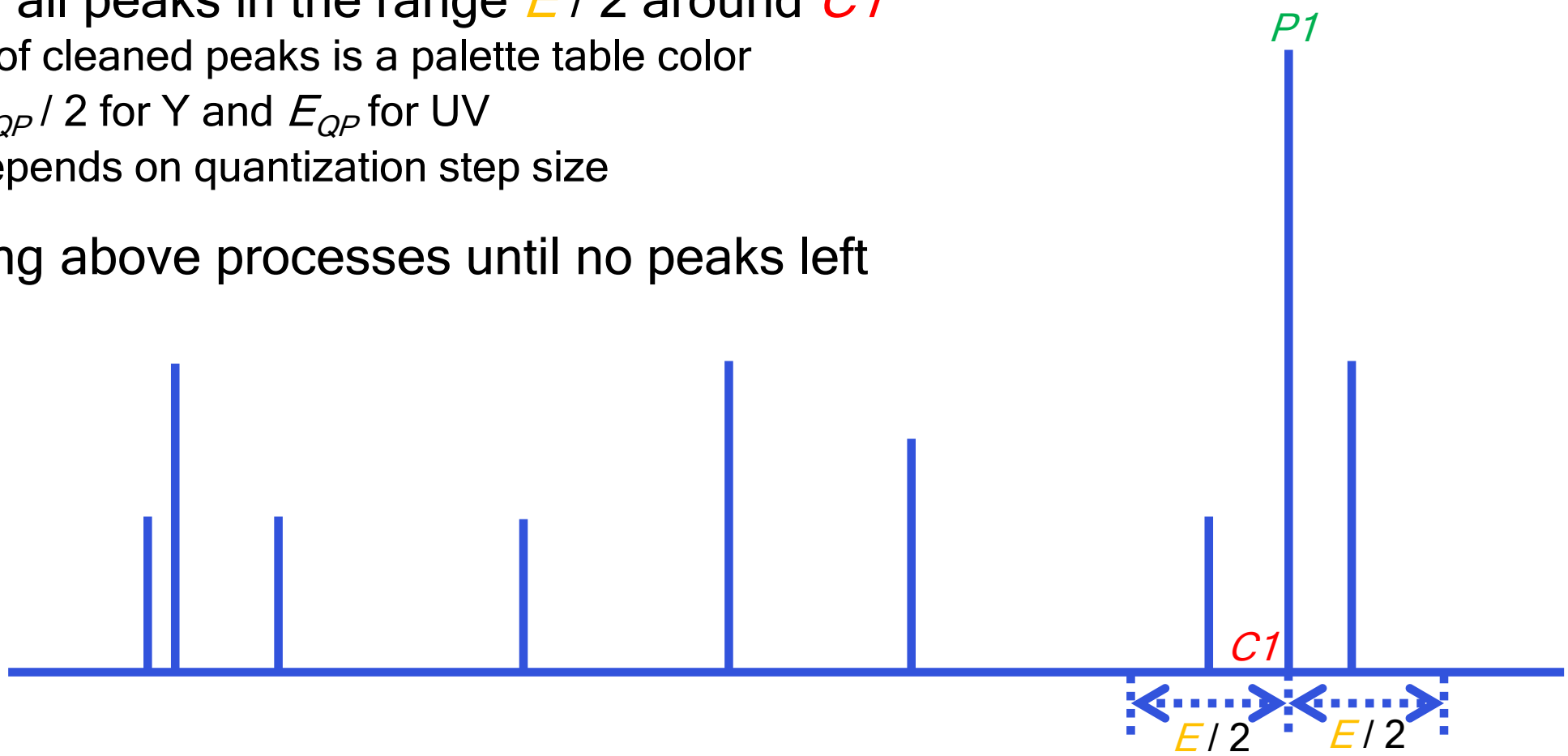
Qualcomm

Current Color Generation Method in Palette Mode (CE8-2.1)

- Scanning all pixels in the CU
- For a new scanned pixel
  - Calculating the difference between the pixel value and each color group mean
  - Classifying the pixel to the color group with the minimum difference
  - Updating the mean of the selected color group
- Palette Table color
  - Each color group mean

Proposed Method

- Constructing the histogram of the CU
- Finding the color *C1* with the largest pixel number *P1*
- Cleaning all peaks in the range *E* / 2 around *C1*
  - Mean of cleaned peaks is a palette table color
  - E is E_{QP} / 2 for Y and E_{QP} for UV
  - E_{QP} depends on quantization step size
- Continuing above processes until no peaks left



Adaptive Selection Algorithm

- The maximum pixel number of peak ≤ 3 after scanning 1 / 16 total pixels in CU
- Using original color generation method instead

Experimental Results

- Anchor: VTM 5.0
- Test
  - CE8-2.1.
  - CE8-2.1. + proposed 2 methods

Experimental Results, 4:2:0

	All Intra Main10					Random Access Main 10					Low delay B Main10				
	Over VTM-5.0, CTC					Over VTM-5.0, CTC					Over VTM-5.0, CTC				
	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
Class A1	0.00%	-0.03%	-0.02%	107%	105%	0.02%	-0.10%	0.13%	102%	102%					
Class A2	0.04%	0.07%	0.06%	108%	102%	0.06%	-0.11%	0.12%	100%	99%					
Class B	0.05%	0.02%	0.06%	107%	105%	0.05%	-0.02%	-0.29%	102%	102%	0.01%	0.60%	-0.12%	101%	100%
Class C	0.05%	0.06%	0.06%	108%	106%	0.00%	-0.03%	-0.11%	102%	103%	0.04%	0.23%	-0.12%	100%	104%
Class E	0.06%	0.04%	-0.08%	109%	103%						0.06%	-0.05%	0.02%	100%	98%
Overall	0.04%	0.03%	0.02%	108%	105%	0.03%	-0.06%	-0.08%	102%	102%	0.04%	0.31%	-0.09%	101%	101%
Class D	0.03%	0.26%	-0.02%	106%	105%	0.04%	-0.17%	0.15%	101%	102%	0.06%	0.26%	0.36%	104%	110%
Class F	-0.72%	-0.56%	-0.83%	107%	108%	-0.55%	-0.83%	-0.77%	107%	107%	-0.28%	-0.75%	-0.72%	106%	104%
Class TGM	-4.29%	-4.53%	-3.89%	102%	102%	-1.71%	-2.54%	-2.15%	102%	102%	-0.43%	-0.57%	-0.47%	104%	102%

CE 8-2.1.

	All Intra Main10					Random Access Main 10					Low delay B Main10				
	Over VTM-5.0, CTC					Over VTM-5.0, CTC					Over VTM-5.0, CTC				
	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
Class A1	0.00%	-0.03%	0.00%	111%	102%	0.01%	-0.10%	0.14%	103%	102%					
Class A2	0.05%	0.06%	0.05%	110%	104%	0.06%	-0.10%	0.09%	103%	102%					
Class B	0.05%	0.01%	0.06%	110%	107%	0.04%	-0.06%	-0.23%	103%	103%	0.04%	0.53%	-0.20%	101%	103%
Class C	0.05%	0.06%	0.06%	110%	111%	0.00%	-0.01%	-0.11%	105%	107%	0.04%	0.23%	-0.12%	102%	106%
Class E	0.06%	0.04%	-0.08%	110%	105%						0.06%	-0.05%	0.02%	101%	103%
Overall	0.04%	0.03%	0.02%	110%	106%	0.03%	-0.06%	-0.06%	104%	104%	0.05%	0.29%	-0.12%	101%	104%
Class D	0.03%	0.27%	-0.02%	109%	110%	0.04%	-0.20%	0.15%	104%	109%	0.06%	0.26%	0.36%	105%	102%
Class F	-0.73%	-0.59%	-0.58%	109%	108%	-0.69%	-0.62%	-0.56%	115%	110%	-0.31%	-0.70%	-0.78%	116%	106%
Class TGM	-4.50%	-3.94%	-3.27%	104%	103%	-2.14%	-2.08%	-1.65%	106%	103%	-0.57%	-0.46%	-0.21%	107%	103%

CE 8-2.1. + proposed 2 methods

Experimental Results, 4:4:4, DualITree = 0

	All Intra Main10					Random access Main10					Low delay B Main10				
	Over VTM 5.0, CTC, DT0					Over VTM 5.0, CTC, DT0					Over VTM 5.0, CTC, DT0				
	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
TGM 1080p	-16.41%	-22.86%	-22.49%	99%	87%	-10.64%	-17.44%	-17.01%	92%	92%	-6.54%	-11.48%	-11.07%	100%	96%
TGM 720p	-4.64%	-10.72%	-12.74%	103%	98%	-4.62%	-9.89%	-12.21%	100%	98%	-1.72%	-6.34%	-7.97%	102%	98%
Animation	0.04%	-0.24%	-0.19%	105%	108%	0.05%	-0.16%	-0.17%	103%	100%	0.06%	-0.36%	-0.03%	105%	102%
Mixed content	-0.76%	-4.48%	-5.21%	103%	101%	-0.42%	-3.11%	-4.17%	103%	100%	0.52%	-1.99%	-3.20%	103%	98%
Camera-Captured content	0.01%	0.01%	0.04%	104%	102%	-0.01%	0.24%	0.18%	100%	98%	-0.03%	0.04%	-0.12%	101%	99%
Overall	-5.76%	-9.88%	-10.46%	102%	97%	-4.15%	-7.90%	-8.62%	99%	97%	-2.09%	-5.19%	-5.74%	102%	98%

CE 8-2.1.

	All Intra Main10					Random access Main10					Low delay B Main10				
	Over VTM 5.0, CTC, DT0					Over VTM 5.0, CTC, DT0					Over VTM 5.0, CTC, DT0				
	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
TGM 1080p	-16.45%	-22.34%	-22.01%	100%	91%	-10.77%	-17.05%	-16.67%	91%	92%	-6.29%	-11.02%	-10.63%	102%	101%
TGM 720p	-4.67%	-9.75%	-11.35%	104%	100%	-4.77%	-8.94%	-11.84%	104%	100%	-1.81%	-5.48%	-7.06%	104%	97%
Animation	0.03%	-0.19%	-0.22%	105%	107%	0.03%	-0.21%	-0.11%	113%	104%	0.08%	-0.14%	-0.26%	115%	104%
Mixed content	-0.86%	-4.19%	-4.77%	104%	104%	-0.36%	-3.29%	-3.76%	109%	101%	0.37%	-2.43%	-3.65%	108%	101%
Camera-Captured content	0.01%	0.01%	0.04%	106%	104%	-0.01%	0.24%	0.18%	104%	103%	-0.03%	0.04%	-0.12%	101%	104%
Overall	-5.80%	-9.42%	-9.87%	103%	100%	-4.22%	-7.58%	-8.35%	102%	99%	-2.08%	-4.90%	-5.49%	105%	101%

CE 8-2.1. + proposed 2 methods

Experimental Results, 4:4:4, DualITree = 1

	All Intra Main10					Random access Main10					Low delay B Main10				
	Over VTM 5.0, CTC, DT1					Over VTM 5.0, CTC, DT1					Over VTM 5.0, CTC, DT1				
	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
TGM 1080p	-6.54%	-13.69%	-13.62%	107%	91%	-5.40%	-13.28%	-12.89%	93%	93%	-5.43%	-10.81%	-10.28%	101%	95%
TGM 720p	-1.58%	-7.03%	-8.55%	106%	100%	-0.74%	-7.07%	-8.29%	101%	99%	-1.13%	-5.67%	-6.86%	102%	99%
Animation	0.06%	-1.10%	-0.75%	104%	104%	0.09%	-0.46%	-0.36%	105%	104%	0.03%	-0.22%	-0.26%	108%	97%
Mixed content	0.11%	-5.74%	-5.58%	105%	101%	-0.45%	-6.84%	-6.12%	103%	99%	-0.24%	-6.25%	-5.92%	104%	97%
Camera-Captured content	0.06%	0.03%	0.02%	106%	101%	0.05%	0.08%	-0.06%	104%	105%	0.04%	-0.07%	0.00%	101%	102%
Overall	-2.13%	-6.81%	-7.13%	106%	98%	-1.71%	-6.85%	-6.93%	100%	99%	-1.79%	-5.68%	-5.79%	103%	98%

CE 8-2.1.

	All Intra Main10					Random access Main10					Low delay B Main10				
	Over VTM 5.0, CTC, DT1					Over VTM 5.0, CTC, DT1					Over VTM 5.0, CTC, DT1				
	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
TGM 1080p	-7.14%	-13.36%	-13.45%	110%	98%	-5.93%	-12.78%	-12.16%	97%	98%	-5.08%	-10.00%	-9.55%	102%	99%
TGM 720p	-2.07%	-6.66%	-8.33%	108%	103%	-1.42%	-6.45%	-7.75%	101%	97%	-1.09%	-4.90%	-6.03%	104%	99%
Animation	0.05%	-1.04%	-0.73%	108%	112%	0.04%	-0.40%	-0.32%	115%	105%	0.04%	-0.24%	-0.26%	118%	100%
Mixed content	-0.18%	-5.50%	-5.19%	109%	104%	-0.61%	-6.13%	-5.46%	110%	100%	-0.76%	-6.41%	-5.69%	109%	99%
Camera-Captured content	0.06%	0.03%	0.02%	110%	104%	0.05%	0.08%	-0.06%	105%	105%	0.04%	-0.07%	0.00%	101%	103%
Overall	-2.48%	-6.57%	-6.94%	109%	103%	-2.07%	-6.40%	-6.45%	104%	100%	-1.79%	-5.29%	-5.33%	106%	100%

CE 8-2.1. + proposed 2 methods

Conclusion

- 2 Encoder-only changes
  - New color generation method for palette mode
  - Adaptive selection method
- We thank W. Zhu (ByteDance) for crosschecking.