



Non-RCE4: Run coding for palette mode

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Palette mode JCTVC–00218/RCE4 Test2

- 2 prediction modes to code the block of indexes:
 - Run mode
 - Copy above mode
- For both modes a **run** value is coded to indicate the number of following indexes predicted with the current mode:

```
If(run_mode_flag)
    Decode(palette_index)
    Decode(Run)
Else
    Decode(Run)
```

} Run mode

} Copy above mode

- In JCTVC–00218, the run is coded with the same binarization process as the `coeff_abs_level_remaining` with **cRiceParam = 3**.

Proposal: 1st modification

- Adapt `cRiceParam_run` to the prediction mode and palette index as the following:

```
If(!run_mode_flag || palette_index == 0)
    cRiceParam_run = 2
else
    cRiceParam_run = 0
```

Proposal: 2d modification

■ Limit the coding of the run for « Run mode »:

- The coding of run is avoided according to the coded Palette index as the following:

```
If(palette_index <= Limit_run )  
    Decode(Run)  
else  
    Run = 0
```

■ The Limit_run value is coded for each CU at the beginning of each Palette CU.

Experiments results: Modification 1

- Anchor: Rext 5.1 + O0218
- Test: Rext 5.1 + O0218 + adapt cRiceParam_run

- Results AI/RA/LB:
 - SC:
3.2%/1.6%/2.1%
 - OSC:
3.8%/2.8%/2.3%

	All Intra Main-tier			All Intra High-tier			All Intra Super-High-tier		
	Y	U	V	Y	U	V	Y	U	V
Class F	-0.2%	-0.9%	-0.5%	-0.3%	-0.6%	-0.5%	-0.3%	-0.4%	-0.4%
Class B	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RGB 4:4:4 SC	-3.1%	-2.9%	-2.8%	-3.5%	-3.3%	-3.2%	-3.5%	-3.4%	-3.2%
RGB 4:4:4 Animation	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
YCbCr 4:4:4 SC	-2.4%	-3.6%	-3.9%	-3.3%	-4.3%	-4.4%	-3.5%	-4.0%	-4.1%
YCbCr 4:4:4 Animation	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RangeExt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RGB 4:4:4 SC (Optional)	-3.3%	-3.1%	-3.3%	-3.9%	-3.8%	-3.9%	-4.2%	-4.1%	-4.2%
YCbCr 4:4:4 SC (Optional)	-3.1%	-4.2%	-4.3%	-4.1%	-4.4%	-4.5%	-4.3%	-4.4%	-4.4%
Enc Time[%]	99%			99%			99%		
Dec Time[%]	100%			100%			100%		

	Random Access Main-tier			Random Access High-tier		
	Y	U	V	Y	U	V
Class F	-0.1%	-0.9%	-0.3%	-0.1%	-0.5%	-0.2%
Class B	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RGB 4:4:4 SC	-3.1%	-2.8%	-2.7%	-3.2%	-3.1%	-3.0%
RGB 4:4:4 Animation	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
YCbCr 4:4:4 SC	-2.5%	-3.8%	-4.3%	-3.1%	-4.2%	-4.5%
YCbCr 4:4:4 Animation	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RangeExt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RGB 4:4:4 SC (Optional)	-2.8%	-2.5%	-2.7%	-3.4%	-3.2%	-3.3%
YCbCr 4:4:4 SC (Optional)	-2.4%	-3.3%	-3.6%	-2.8%	-3.1%	-3.1%
Enc Time[%]	99%			99%		
Dec Time[%]	102%			102%		

	Low delay B Main-tier			Low delay B High-tier		
	Y	U	V	Y	U	V
Class F	-0.1%	-0.7%	-0.3%	-0.1%	-0.2%	-0.2%
Class B	0.0%	-0.1%	0.0%	0.0%	0.0%	0.0%
RGB 4:4:4 SC	-2.3%	-2.0%	-2.2%	-2.3%	-2.2%	-2.2%
RGB 4:4:4 Animation	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
YCbCr 4:4:4 SC	-1.6%	-2.6%	-3.0%	-2.3%	-2.9%	-3.3%
YCbCr 4:4:4 Animation	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%
RangeExt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RGB 4:4:4 SC (Optional)	-1.3%	-1.2%	-1.3%	-2.7%	-2.7%	-2.8%
YCbCr 4:4:4 SC (Optional)	-2.5%	-3.2%	-3.6%	-2.6%	-3.0%	-3.3%
Enc Time[%]	99%			99%		
Dec Time[%]	100%			100%		

Experiments results: Modification 2

■ Anchor: Rext 5.1 + O0218

■ Test: Rext 5.1 + O0218 + Limit run

■ Results AI/RA/LB:

● SC:
3.7%/1.9%/2.6%

● OSC:
4.4%/3.4%/2.4%

	All Intra Main-tier			All Intra High-tier			All Intra Super-High-tier		
	Y	U	V	Y	U	V	Y	U	V
Class F	-0.1%	-0.4%	-0.2%	-0.2%	-0.3%	-0.2%	-0.2%	-0.2%	-0.2%
Class B	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RGB 4:4:4 SC	-3.7%	-3.4%	-3.3%	-3.9%	-3.8%	-3.6%	-3.9%	-3.8%	-3.6%
RGB 4:4:4 Animation	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
YCbCr 4:4:4 SC	-2.8%	-4.2%	-4.5%	-3.8%	-4.8%	-4.9%	-3.9%	-4.5%	-4.5%
YCbCr 4:4:4 Animation	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RangeExt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RGB 4:4:4 SC (Optional)	-3.9%	-3.8%	-3.9%	-4.4%	-4.3%	-4.4%	-4.7%	-4.7%	-4.7%
YCbCr 4:4:4 SC (Optional)	-3.9%	-5.1%	-5.3%	-4.6%	-5.1%	-5.2%	-4.9%	-4.9%	-5.0%
Enc Time[%]		98%			98%			98%	
Dec Time[%]		98%			98%			98%	

	Random Access Main-tier			Random Access High-tier		
	Y	U	V	Y	U	V
Class F	-0.2%	-0.5%	-0.2%	-0.2%	-0.4%	-0.2%
Class B	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RGB 4:4:4 SC	-3.6%	-3.3%	-3.2%	-3.5%	-3.4%	-3.3%
RGB 4:4:4 Animation	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
YCbCr 4:4:4 SC	-2.8%	-4.2%	-4.8%	-3.4%	-4.6%	-4.9%
YCbCr 4:4:4 Animation	0.0%	0.0%	-0.1%	0.0%	0.0%	-0.1%
RangeExt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RGB 4:4:4 SC (Optional)	-3.1%	-2.9%	-3.0%	-3.7%	-3.4%	-3.5%
YCbCr 4:4:4 SC (Optional)	-3.2%	-4.4%	-4.8%	-3.5%	-4.0%	-4.2%
Enc Time[%]		99%			99%	
Dec Time[%]		105%			104%	

	Low delay B Main-tier			Low delay B High-tier		
	Y	U	V	Y	U	V
Class F	-0.1%	-0.5%	-0.2%	-0.1%	-0.1%	-0.1%
Class B	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RGB 4:4:4 SC	-2.8%	-2.5%	-2.5%	-2.8%	-2.6%	-2.7%
RGB 4:4:4 Animation	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
YCbCr 4:4:4 SC	-1.9%	-3.2%	-3.7%	-2.8%	-3.6%	-3.9%
YCbCr 4:4:4 Animation	0.0%	-0.1%	0.0%	0.0%	0.0%	0.0%
RangeExt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RGB 4:4:4 SC (Optional)	-2.3%	-2.1%	-2.3%	-3.0%	-3.0%	-3.0%
YCbCr 4:4:4 SC (Optional)	-1.9%	-2.6%	-3.2%	-2.2%	-2.6%	-2.8%
Enc Time[%]		99%			100%	
Dec Time[%]		97%			96%	

Experiments results: Modification 1+2

- Anchor: Rext 5.1 + O0218
- Test: Rext 5.1 + O0218 + + adapt cRiceParam_run + Limit run

■ Results AI/RA/LB:

- SC:
4.2%/4.0%/3.0%
- OSC:
4.4%/3.4%/2.4%

	All Intra Main-tier			All Intra High-tier			All Intra Super-High-tier		
	Y	U	V	Y	U	V	Y	U	V
Class F	-0.3%	-0.9%	-0.5%	-0.4%	-0.6%	-0.5%	-0.3%	-0.4%	-0.4%
Class B	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RGB 4:4:4 SC	-4.2%	-3.8%	-3.8%	-4.5%	-4.3%	-4.1%	-4.4%	-4.3%	-4.1%
RGB 4:4:4 Animation	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
YCbCr 4:4:4 SC	-3.3%	-4.8%	-5.1%	-4.4%	-5.6%	-5.7%	-4.4%	-5.1%	-5.2%
YCbCr 4:4:4 Animation	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RangeExt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RGB 4:4:4 SC (Optional)	-3.9%	-3.7%	-3.9%	-4.5%	-4.3%	-4.5%	-4.9%	-4.7%	-4.8%
YCbCr 4:4:4 SC (Optional)	-3.8%	-5.1%	-5.3%	-4.8%	-5.2%	-5.4%	-5.1%	-5.2%	-5.2%
Enc Time[%]	98%			98%			98%		
Dec Time[%]	99%			99%			100%		

	Random Access Main-tier			Random Access High-tier		
	Y	U	V	Y	U	V
Class F	-0.2%	-0.9%	-0.3%	-0.2%	-0.5%	-0.2%
Class B	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RGB 4:4:4 SC	-4.4%	-4.1%	-3.9%	-4.4%	-4.2%	-4.1%
RGB 4:4:4 Animation	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
YCbCr 4:4:4 SC	-3.2%	-4.8%	-5.3%	-3.9%	-5.2%	-5.5%
YCbCr 4:4:4 Animation	0.0%	-0.1%	-0.1%	0.0%	0.0%	0.0%
RangeExt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RGB 4:4:4 SC (Optional)	-3.3%	-3.0%	-3.1%	-3.8%	-3.6%	-3.7%
YCbCr 4:4:4 SC (Optional)	-3.2%	-4.5%	-5.0%	-3.7%	-4.2%	-4.4%
Enc Time[%]	100%			100%		
Dec Time[%]	101%			101%		

	Low delay B Main-tier			Low delay B High-tier		
	Y	U	V	Y	U	V
Class F	-0.1%	-0.8%	0.0%	-0.1%	-0.3%	-0.1%
Class B	0.0%	-0.1%	0.0%	0.0%	0.0%	0.0%
RGB 4:4:4 SC	-3.3%	-3.0%	-3.1%	-3.3%	-3.2%	-3.2%
RGB 4:4:4 Animation	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
YCbCr 4:4:4 SC	-2.2%	-3.6%	-4.0%	-3.1%	-4.0%	-4.3%
YCbCr 4:4:4 Animation	0.0%	-0.1%	0.1%	0.0%	0.0%	0.1%
RangeExt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RGB 4:4:4 SC (Optional)	-2.1%	-2.0%	-2.1%	-3.2%	-3.1%	-3.1%
YCbCr 4:4:4 SC (Optional)	-2.7%	-3.7%	-4.0%	-3.0%	-3.6%	-3.7%
Enc Time[%]	100%			100%		
Dec Time[%]	98%			98%		

Experiments results: Modification 1 vs RCE4.2

- Anchor: RCE4 Test 2
- Test: RCE4 Test 2+ Limit run

■ Results AI/RA/LB:

- SC:
0.7%/0.8%/0.3%
- SC:
0.9%/0.7%/0.6%

	All Intra Main-tier			All Intra High-tier			All Intra Super-High-tier		
	Y	U	V	Y	U	V	Y	U	V
Class F	-0.1%	-0.1%	0.0%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%
Class B	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RGB 4:4:4 SC	-0.7%	-0.7%	-0.6%	-0.7%	-0.7%	-0.7%	-0.7%	-0.7%	-0.7%
RGB 4:4:4 Animation	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
YCbCr 4:4:4 SC	-0.6%	-0.6%	-0.6%	-0.7%	-0.7%	-0.7%	-0.7%	-0.7%	-0.7%
YCbCr 4:4:4 Animation	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RangeExt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RGB 4:4:4 SC (Optional)	-0.9%	-0.9%	-0.9%	-1.0%	-0.9%	-0.9%	-1.0%	-1.0%	-1.0%
YCbCr 4:4:4 SC (Optional)	-0.9%	-0.9%	-0.9%	-0.9%	-0.9%	-0.9%	-1.0%	-0.9%	-0.9%
Enc Time[%]	97.7%			97.7%			97.7%		
Dec Time[%]	91.4%			90.9%			91.3%		

	Random Access Main-tier			Random Access High-tier		
	Y	U	V	Y	U	V
Class F	0.0%	0.0%	-0.1%	0.0%	0.0%	-0.1%
Class B	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RGB 4:4:4 SC	-0.8%	-0.8%	-0.7%	-0.9%	-0.9%	-0.9%
RGB 4:4:4 Animation	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
YCbCr 4:4:4 SC	-0.8%	-0.8%	-0.8%	-0.9%	-0.9%	-0.9%
YCbCr 4:4:4 Animation	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RangeExt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RGB 4:4:4 SC (Optional)	-0.7%	-0.7%	-0.7%	-0.9%	-0.9%	-0.9%
YCbCr 4:4:4 SC (Optional)	-0.6%	-0.5%	-0.6%	-0.6%	-0.5%	-0.5%
Enc Time[%]	99.2%			99.0%		
Dec Time[%]	93.1%			94.0%		

	Low delay B Main-tier			Low delay B High-tier		
	Y	U	V	Y	U	V
Class F	0.0%	-0.2%	0.2%	0.1%	0.0%	0.0%
Class B	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RGB 4:4:4 SC	-0.2%	-0.1%	-0.2%	-0.3%	-0.3%	-0.3%
RGB 4:4:4 Animation	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
YCbCr 4:4:4 SC	-0.3%	-0.2%	-0.4%	-0.4%	-0.4%	-0.4%
YCbCr 4:4:4 Animation	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RangeExt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RGB 4:4:4 SC (Optional)	0.2%	0.1%	0.1%	-0.2%	-0.2%	-0.2%
YCbCr 4:4:4 SC (Optional)	-1.2%	-1.2%	-1.2%	-1.0%	-0.9%	-1.0%
Enc Time[%]	100.4%			100.1%		
Dec Time[%]	92.6%			93.3%		

Conclusion

- Recommend to consider these modifications if the Palette Mode coding is adopted for the Range Extensions.