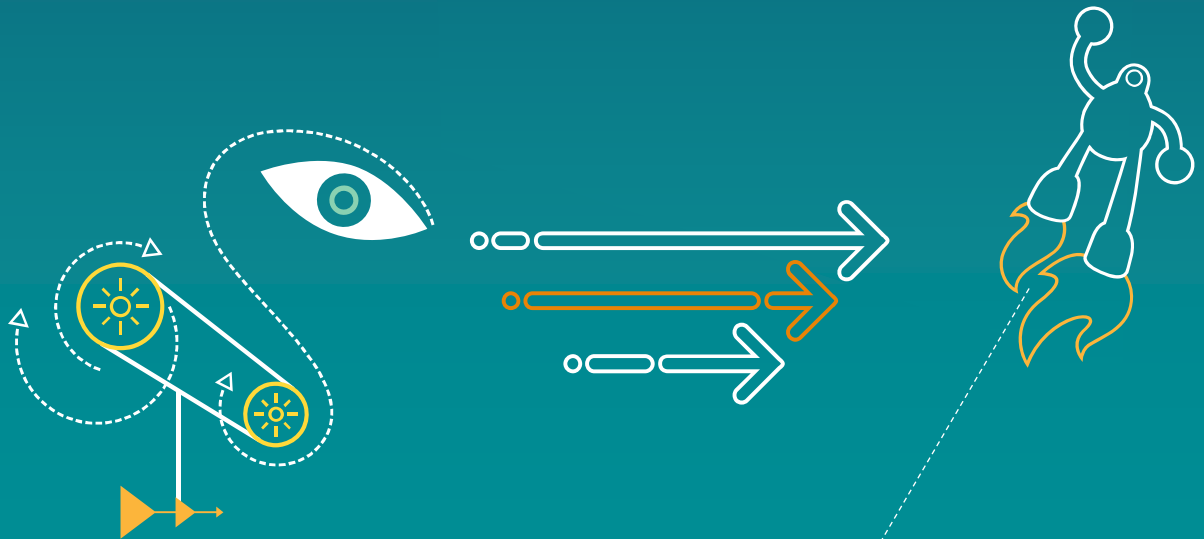


V. Seregin, M. Karczewicz, W. Pu, R. Joshi, J. Sole

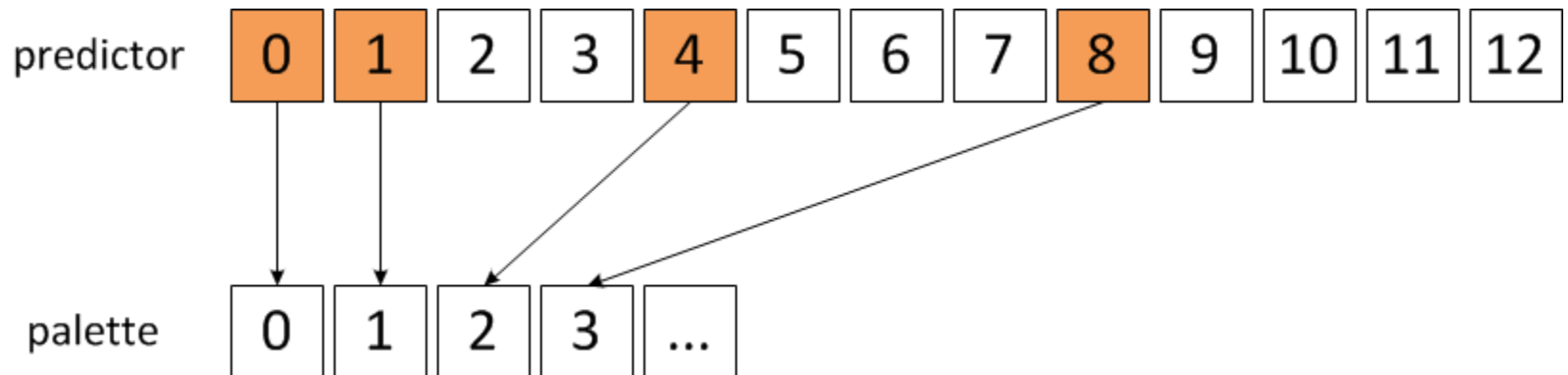
JCTVC-R0228

Non-SCCE3: Run-length coding for palette predictor



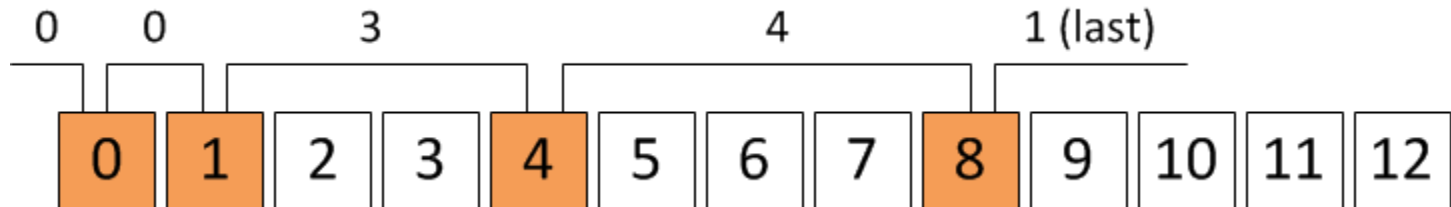
Palette predictor in SCCE3 base

- Palette entries can be predicted from the palette predictor
- Palette predictor is composed from palette entries of the previously coded CUs
- Binary vector of 0s and 1s is signaled per CU to indicate prediction
- For example, binary vector {1100100010000} indicates that entries 0, 1, 4, and 8 are reused from the predictor



Binary vector coding

- Proposed a run-length coding based on “Run-length encodings,” S.W. Golomb, IEEE Trans. Information Theory, July 1966:
 - the number of preceding zero elements is coded for every 1 in the binary vector
 - if the number of zero elements is greater than 0, the number plus one is signaled, due to the escape value of 1
 - run-length value is coded using 0-order Exponential Golomb code
 - run-length value equal to 1 indicates end of prediction
 - the end of prediction is not signaled for the last 1 in the binary vector
- Example: {1100100010000}
- Signalled: 0-0-3-4-1



On top of SCCE3 base (lossy)

SCCE3 A.8

Proposal, pred. size 64

Proposal, pred. size 128

Full Frame IBC	All Intra		
	G/Y	B/U	R/V
RGB, text & graphics with motion, 1080p	-3.3%	-3.3%	-3.2%
RGB, text & graphics with motion, 720p	-3.1%	-3.0%	-3.0%
RGB, mixed content, 1440p	-0.2%	-0.2%	-0.2%
RGB, mixed content, 1080p	-0.3%	-0.4%	-0.3%
RGB, Animation, 720p	0.0%	0.0%	0.0%
RGB, camera captured, 1080p	0.0%	0.0%	0.0%
YUV, text & graphics with motion, 1080p	-3.4%	-3.6%	-3.5%
YUV, text & graphics with motion, 720p	-2.3%	-2.8%	-3.3%
YUV, mixed content, 1440p	-0.2%	-0.3%	-0.3%
YUV, mixed content, 1080p	-0.5%	-0.5%	-0.4%
YUV, Animation, 720p	0.0%	0.0%	0.0%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%
Enc Time[%]	101%		
Dec Time[%]	100%		

All Intra		
G/Y	B/U	R/V
-3.4%	-3.4%	-3.4%
-3.3%	-3.1%	-3.1%
-0.2%	-0.2%	-0.2%
-0.4%	-0.4%	-0.3%
0.0%	0.0%	0.0%
0.0%	0.0%	0.0%
-3.6%	-3.8%	-3.6%
-2.4%	-2.9%	-3.4%
-0.2%	-0.4%	-0.4%
-0.5%	-0.5%	-0.5%
0.0%	0.0%	0.0%
0.0%	0.0%	0.0%
104%		
100%		

All Intra		
G/Y	B/U	R/V
-4.0%	-3.9%	-3.9%
-3.6%	-3.4%	-3.4%
-0.3%	-0.3%	-0.3%
-0.4%	-0.4%	-0.4%
0.0%	0.0%	0.0%
0.0%	0.0%	0.0%
-4.0%	-4.3%	-4.1%
-2.5%	-3.1%	-3.7%
-0.2%	-0.4%	-0.4%
-0.6%	-0.6%	-0.6%
0.0%	0.0%	0.0%
0.0%	0.0%	0.0%
104%		
100%		

2CTU IBC	All Intra		
	G/Y	B/U	R/V
RGB, text & graphics with motion, 1080p	-4.0%	-4.0%	-3.9%
RGB, text & graphics with motion, 720p	-3.9%	-3.8%	-3.8%
RGB, mixed content, 1440p	-0.3%	-0.3%	-0.3%
RGB, mixed content, 1080p	-0.5%	-0.5%	-0.5%
RGB, Animation, 720p	0.0%	0.0%	0.0%
RGB, camera captured, 1080p	0.0%	0.0%	0.0%
YUV, text & graphics with motion, 1080p	-3.9%	-4.1%	-4.1%
YUV, text & graphics with motion, 720p	-3.1%	-3.5%	-3.8%
YUV, mixed content, 1440p	-0.3%	-0.5%	-0.5%
YUV, mixed content, 1080p	-0.6%	-0.9%	-0.8%
YUV, Animation, 720p	0.0%	0.0%	0.0%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%
Enc Time[%]	104%		
Dec Time[%]	105%		

All Intra		
G/Y	B/U	R/V
-4.2%	-4.2%	-4.1%
-4.1%	-3.9%	-4.0%
-0.3%	-0.3%	-0.3%
-0.5%	-0.5%	-0.5%
0.0%	0.0%	0.0%
0.0%	0.0%	0.0%
-4.1%	-4.3%	-4.2%
-3.3%	-3.6%	-4.0%
-0.3%	-0.5%	-0.5%
-0.7%	-0.9%	-0.8%
0.0%	0.0%	0.0%
0.0%	0.0%	0.0%
102%		
98%		

All Intra		
G/Y	B/U	R/V
-4.8%	-4.8%	-4.7%
-4.5%	-4.4%	-4.4%
-0.5%	-0.5%	-0.5%
-0.7%	-0.7%	-0.7%
0.0%	0.0%	0.0%
0.0%	0.0%	0.0%
-4.6%	-5.0%	-4.9%
-3.5%	-3.9%	-4.4%
-0.5%	-0.8%	-0.8%
-0.9%	-1.2%	-1.2%
0.0%	0.0%	0.0%
0.0%	0.0%	0.0%
103%		
96%		

On top of SCCE3 C4v3 (lossy)

SCCE3 A.8

Proposal, pred. size 64

Proposal, pred. size 128

Full Frame IBC	All Intra		
	G/Y	B/U	R/V
RGB, text & graphics with motion, 1080p	-11.2%	-10.9%	-10.7%
RGB, text & graphics with motion, 720p	-9.6%	-8.4%	-8.6%
RGB, mixed content, 1440p	-5.2%	-4.2%	-4.4%
RGB, mixed content, 1080p	-5.2%	-4.9%	-4.8%
RGB, Animation, 720p	-0.2%	-0.6%	-0.7%
RGB, camera captured, 1080p	0.1%	0.1%	0.0%
YUV, text & graphics with motion, 1080p	-11.5%	-13.0%	-12.7%
YUV, text & graphics with motion, 720p	-6.4%	-9.3%	-11.3%
YUV, mixed content, 1440p	-4.1%	-8.8%	-9.1%
YUV, mixed content, 1080p	-4.8%	-9.3%	-9.3%
YUV, Animation, 720p	0.1%	-1.4%	-1.3%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%
Enc Time[%]	104%		
Dec Time[%]	98%		

	All Intra		
	G/Y	B/U	R/V
RGB, text & graphics with motion, 1080p	-11.5%	-11.2%	-11.0%
RGB, text & graphics with motion, 720p	-9.9%	-8.6%	-8.8%
RGB, mixed content, 1440p	-5.4%	-4.4%	-4.5%
RGB, mixed content, 1080p	-5.4%	-5.0%	-5.0%
RGB, Animation, 720p	-0.3%	-0.7%	-0.8%
RGB, camera captured, 1080p	0.1%	0.1%	0.0%
YUV, text & graphics with motion, 1080p	-11.8%	-13.3%	-13.0%
YUV, text & graphics with motion, 720p	-6.6%	-9.5%	-11.6%
YUV, mixed content, 1440p	-4.3%	-9.0%	-9.3%
YUV, mixed content, 1080p	-4.9%	-9.5%	-9.5%
YUV, Animation, 720p	0.1%	-1.4%	-1.3%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%
Enc Time[%]	103%		
Dec Time[%]	97%		

	All Intra		
	G/Y	B/U	R/V
RGB, text & graphics with motion, 1080p	-12.1%	-11.8%	-11.7%
RGB, text & graphics with motion, 720p	-10.2%	-8.9%	-9.1%
RGB, mixed content, 1440p	-5.8%	-4.8%	-5.0%
RGB, mixed content, 1080p	-5.6%	-5.3%	-5.2%
RGB, Animation, 720p	-0.3%	-0.7%	-0.8%
RGB, camera captured, 1080p	0.1%	0.1%	0.0%
YUV, text & graphics with motion, 1080p	-12.2%	-13.8%	-13.4%
YUV, text & graphics with motion, 720p	-6.7%	-9.6%	-11.8%
YUV, mixed content, 1440p	-4.5%	-9.5%	-9.8%
YUV, mixed content, 1080p	-5.3%	-9.8%	-10.1%
YUV, Animation, 720p	0.1%	-1.4%	-1.3%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%
Enc Time[%]	105%		
Dec Time[%]	99%		

2CTU IBC	All Intra		
	G/Y	B/U	R/V
RGB, text & graphics with motion, 1080p	-13.2%	-12.8%	-12.7%
RGB, text & graphics with motion, 720p	-11.5%	-10.3%	-10.6%
RGB, mixed content, 1440p	-6.8%	-5.7%	-5.9%
RGB, mixed content, 1080p	-7.4%	-7.0%	-7.1%
RGB, Animation, 720p	-0.3%	-0.6%	-0.7%
RGB, camera captured, 1080p	0.1%	0.1%	0.0%
YUV, text & graphics with motion, 1080p	-13.6%	-15.1%	-14.9%
YUV, text & graphics with motion, 720p	-8.4%	-11.1%	-13.1%
YUV, mixed content, 1440p	-5.8%	-10.7%	-11.0%
YUV, mixed content, 1080p	-7.3%	-12.1%	-12.1%
YUV, Animation, 720p	0.1%	-1.5%	-1.3%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%
Enc Time[%]	101%		
Dec Time[%]	95%		

	All Intra		
	G/Y	B/U	R/V
RGB, text & graphics with motion, 1080p	-13.5%	-13.2%	-13.0%
RGB, text & graphics with motion, 720p	-11.9%	-10.6%	-10.9%
RGB, mixed content, 1440p	-7.0%	-5.9%	-6.1%
RGB, mixed content, 1080p	-7.7%	-7.2%	-7.2%
RGB, Animation, 720p	-0.3%	-0.7%	-0.8%
RGB, camera captured, 1080p	0.1%	0.1%	0.0%
YUV, text & graphics with motion, 1080p	-13.9%	-15.4%	-15.2%
YUV, text & graphics with motion, 720p	-8.6%	-11.4%	-13.4%
YUV, mixed content, 1440p	-6.0%	-11.0%	-11.3%
YUV, mixed content, 1080p	-7.4%	-12.4%	-12.3%
YUV, Animation, 720p	0.1%	-1.5%	-1.3%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%
Enc Time[%]	104%		
Dec Time[%]	96%		

	All Intra		
	G/Y	B/U	R/V
RGB, text & graphics with motion, 1080p	-14.2%	-13.9%	-13.8%
RGB, text & graphics with motion, 720p	-12.2%	-10.9%	-11.2%
RGB, mixed content, 1440p	-7.6%	-6.5%	-6.7%
RGB, mixed content, 1080p	-8.1%	-7.7%	-7.7%
RGB, Animation, 720p	-0.3%	-0.7%	-0.8%
RGB, camera captured, 1080p	0.1%	0.1%	0.0%
YUV, text & graphics with motion, 1080p	-14.4%	-16.0%	-15.7%
YUV, text & graphics with motion, 720p	-8.8%	-11.6%	-13.6%
YUV, mixed content, 1440p	-6.3%	-11.6%	-11.8%
YUV, mixed content, 1080p	-7.9%	-12.8%	-12.8%
YUV, Animation, 720p	0.1%	-1.5%	-1.3%
YUV, camera captured, 1080p	0.0%	0.0%	0.0%
Enc Time[%]	105%		
Dec Time[%]	95%		

Conclusion

- Run-length coding is proposed for palette predictor coding
- Experimental results (full frame IBC)
 - On top of SCCE3 base: up to 3.6% luma BD-rate gain
 - On top of SCCE3 C4v3: up to 11.8% luma BD-rate gain
- Additional gain up to 0.6% luma BD-rate gain can be achieved by increasing predictor size to 128