Single color intra mode for screen content coding

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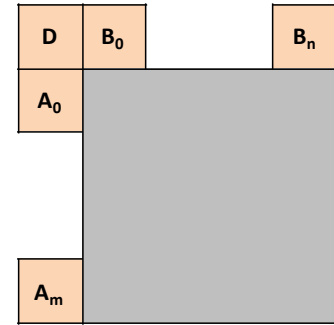
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Overall Summary

- A coding mode "Single Color Mode" is proposed to efficiently code the smooth area of a picture

- The concept is to simply reconstruct the current CU as a smooth area with single color value.

- Provide overall 0.8% BD-rate savings for the average of difference classes of SCC sequences
  - Up to 1.3%, 1.7%, 1.0% and 1.6% for some classes

- The decoding time is reduced since the parsing and reconstruction of single color mode is simple.

Syntax of Single Depth Mode

- Three additional syntax are introduced.
  - A slice-level enabling flag
  - One CU-level flag is further signaled to indicate the enabling of the single color mode for each CU.
  - A candidate index is signaled in the bitstream to indicate which sample candidate is selected to fill the current CU.

Reconstruction of Single Color Mode

- A sample candidate list is first constructed.
  - $A_m \rightarrow B_n \rightarrow B_0 \rightarrow A_0 \rightarrow D$
  - The size of candidate list is fixed to 2.
  - A redundancy checking is performed.

- If empty entry exists in the candidate list, default candidates will be used to fill in those empty entries.
  - Default value is $1 << (\text{bitdepth}-1)$

- A candidate index is signaled in the bitstream to indicate which sample candidate is selected to fill the current CU.

Lossy Coding Result

- Anchor: RExt6.0, Tested: RExt6.0+ single color mode

- SCC CfP test sequences

- 1.3%/1.7%/1.0%/1.6% gains for sequences of "RGB and YUV text& graphics with motion" under AI

- Thank Microsoft for cross-verification.

BD-rate Y	All Intra	Random Access	Low delay B
RGB, text & graphics with motion, 1080p	-1.3%	-0.1%	-0.1%
RGB, text & graphics with motion,720p	-1.7%	-0.8%	0.1%
RGB, mixed content, 1440p	-0.7%	-0.1%	0.1%
RGB, mixed content, 1080p	-0.4%	-0.1%	0.0%
RGB, Animation, 720p	-0.1%	0.0%	0.0%
YUV, text & graphics with motion, 1080p	-1.0%	-0.3%	0.1%
YUV, text & graphics with motion,720p	-1.6%	-0.8%	-0.2%
YUV, mixed content, 1440p	-0.7%	-0.1%	0.1%
YUV, mixed content, 1080p	-0.4%	-0.3%	0.0%
YUV, Animation, 720p	0.0%	0.0%	0.1%

Lossless Coding Result

- Anchor: RExt6.0, Tested: RExt6.0+ single color mode

- SCC CfP test sequences

- 0.4%/0.4%/0.5%/0.5% gain for sequences of "RGB and YUV text& graphics with motion" under AI

BD-rate Y	All Intra	Random Access	Low delay B
RGB, text & graphics with motion, 1080p	0.4%	0.1%	-0.1%
RGB, text & graphics with motion,720p	0.4%	0.2%	0.0%
RGB, mixed content, 1440p	0.1%	0.0%	0.0%
RGB, mixed content, 1080p	0.1%	0.0%	0.0%
RGB, Animation, 720p	0.0%	0.0%	0.0%
YUV, text & graphics with motion, 1080p	0.4%	0.1%	0.0%
YUV, text & graphics with motion,720p	0.5%	0.2%	-0.1%
YUV, mixed content, 1440p	0.1%	0.0%	0.0%
YUV, mixed content, 1080p	0.1%	0.0%	0.0%
YUV, Animation, 720p	0.0%	0.0%	0.0%

Lossy Coding Result

- Anchor: RExt6.0, Tested: RExt6.0+ single color mode

- RExt AhG8 test sequences

- 1.2%/1.3% BD-rate saving for SC RGB444 and SC YUV444 sequences under AI

BD-rate Y	AI-MT	AI-HT	AI-SHT	RA-MT	RA-HT	LB-MT	LB-HT
Class F	-0.4%	-0.3%	-0.2%	-0.2%	-0.2%	-0.2%	-0.1%
Class B	-0.1%	0.0%	0.0%	0.0%	-0.1%	0.0%	0.0%
SC RGB 444	-1.2%	-1.0%	-0.9%	-0.4%	-0.2%	0.2%	0.3%
Animation RGB 444	-0.1%	-0.1%	0.0%	0.1%	0.1%	-0.1%	0.0%
SC YUV 444	-1.3%	-1.1%	-0.9%	-0.5%	-0.4%	-0.2%	-0.2%
Animation YUV 444	-0.1%	0.0%	0.0%	0.2%	0.1%	0.0%	0.1%
RangeExt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
SC(444) GBR Optional	-1.1%	-1.0%	-0.9%	-0.9%	-0.9%	-0.3%	0.0%
SC(444) YUV Optional	-0.9%	-0.7%	-0.6%	-1.0%	-0.8%	-1.2%	-1.2%

Lossless Coding Result

- Anchor: RExt6.0

- RExt AhG8 test sequences

- 0.4%/0.4% BD-rate saving for SC RGB444 and SC YUV444 sequences under AI

	Average bit-rate increase		
	AI	RA	LB
Class F	-0.1%	0.0%	0.0%
Class B	0.0%	0.0%	0.0%
RGB 4:4:4 SC	-0.4%	0.2%	-0.1%
RGB 4:4:4 Animation	0.0%	0.0%	0.0%
YCbCr 4:4:4 SC	-0.4%	-0.4%	0.0%
YCbCr 4:4:4 Animation	0.0%	0.0%	0.0%
RangeExt	0.0%	0.0%	0.0%
RGB 4:4:4 SC (Optional)	-0.4%	-0.8%	-0.2%
YCbCr 4:4:4 SC (Optional)	-0.3%	-0.5%	-1.6%
Enc Time[%]	101%	103%	104%
Dec Time[%]	99%	100%	99%

Conclusions

- Single color mode is proposed to efficiently code the smooth area within a picture.

- Single color mode introduces 1.3%, 1.7%,1.0%,1.6% gains for sequences of "RGB and YUV text& graphics with motion" under AI.

- The parsing and reconstruction of single color mode is simple which is reflected on the reduced decoding time.

  – Reduce by 2 – 3%

- Recommend to be further studied for SCC

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