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CODING OF MOVING PICTURES AND AUDIO

ISO/IEC JTC 1/SC 29/WG 4 **m77039**
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Title: [GSC][VPCC][CE2.8-related] Alternative HM coding configurations for V-PCC amd.1 with block-based sorting

Author: A.Dziembowski, B. Szydełko (PUT)
J. Jung (Qualcomm)

1. Abstract

This informative contribution presents results obtained by modifying the configuration of the HEVC encoder used by V-PCC Amendment 1 to encode raw patch images with block-based sorting enabled. The document combines results from m76215 and m76580.

2. Context and motivation (copied from m76215)

The configuration of the 2D encoder is traditionally optimized for natural video content. However, raw patch images exhibit characteristics that differ significantly from those of typical natural scenes, including distinct texture and statistical properties. As a result, there is no guarantee that a default configuration designed for natural content is well suited for the efficient coding of raw patch images. Consequently, investigating and evaluating alternative encoder configurations specifically adapted to these characteristics is of interest, as it may lead to improved coding performance and efficiency. For that purpose, the Sample Adaptive Offset, Loop Filter, and PCM tools were evaluated.

3. Test 1: Disabling Sample Adaptive Offset

Anchor	Block-based sorting

1F:

Sequence	BD-rate RGB-PSNR	BD-rate YUV-PSNR	BD-rate YUV-SSIM
bartender_semitracked	-0.3%	-0.2%	0.2%
cinema_semitracked	0.0%	0.1%	0.4%
breakfast_semitracked	-0.1%	-0.1%	0.1%
breakfast_untracked	No overlap	No overlap	No overlap
breakdance_untracked	-0.1%	-0.1%	0.2%
bartender_tracked	0.0%	-0.2%	0.0%
cinema_tracked	-0.1%	-0.1%	0.2%
breakfast_tracked	-0.3%	-0.2%	-0.1%
trio			
makeup			
musical			
Average	**-0.1%**	**-0.1%**	**0.1%**
Average over mandatory V-PCC sequences	**-0.1%**	**-0.1%**	**0.1%**

1F:

Sequence	BD-rate RGB-PSNR	BD-rate YUV-PSNR	BD-rate YUV-SSIM
manwithfruit_tracked	0.2%	0.2%	0.6%
lego_ferrari	-0.1%	-0.1%	0.4%
lego_bugatti	0.0%	0.0%	0.4%
cricket_player	0.0%	0.1%	0.6%
plant	0.2%	0.2%	0.6%
solo_tango_female	0.2%	0.2%	0.4%
solo_tango_male	0.2%	0.2%	0.6%
tango_duo	0.2%	0.2%	0.3%
tennis_player	0.0%	0.1%	0.7%
library	No overlap	No overlap	No overlap
flowerdance	-0.8%	-0.7%	-0.3%
gymnast	-0.1%	-0.1%	0.0%
Average	**0.0%**	**0.0%**	**0.4%**
Average over mandatory V-PCC sequences	**0.0%**	**0.0%**	**0.4%**

1F:

Sequence	BD-rate RGB-PSNR	BD-rate YUV-PSNR	BD-rate YUV-SSIM
bartender_semitracked	-0.1%	-0.1%	0.2%
cinema_semitracked	0.0%	0.0%	0.2%
breakfast_semitracked	-0.1%	0.0%	0.1%
breakfast_untracked	0.0%	0.0%	0.0%
breakdance_untracked			
bartender_tracked	-0.1%	-0.1%	0.1%
cinema_tracked	0.2%	0.3%	0.1%
breakfast_tracked	0.0%	0.0%	0.1%
trio			
makeup			
musical			
Average	**0.0%**	**0.0%**	**0.1%**
Average over mandatory V-PCC sequences	**0.0%**	**0.0%**	**0.1%**

1F

Sequence	BD-rate RGB-PSNR	BD-rate YUV-PSNR	BD-rate YUV-SSIM
manwithfruit_tracked	0.2%	0.2%	0.9%
lego_ferrari	No overlap	No overlap	No overlap
lego_bugatti	No overlap	No overlap	No overlap
cricket_player	No overlap	No overlap	No overlap
plant	No overlap	No overlap	No overlap
solo_tango_female	No overlap	No overlap	No overlap
solo_tango_male	No overlap	No overlap	No overlap
tango_duo	No overlap	No overlap	No overlap
tennis_player	No overlap	No overlap	No overlap
library			
flowerdance	No overlap	No overlap	No overlap
gymnast	No overlap	No overlap	No overlap
Average	**0.2%**	**0.2%**	**0.9%**
Average over mandatory V-PCC sequences	**0.2%**	**0.2%**	**0.9%**

Table 1: disabling SAO.

4. Test 2: Disabling Loop Filter

Anchor	Block-based sorting

1F:

Sequence	BD-rate RGB-PSNR	BD-rate YUV-PSNR	BD-rate YUV-SSIM
bartender_semitracked	-0.1%	-0.1%	0.0%
cinema_semitracked	-0.1%	-0.1%	0.0%
breakfast_semitracked	-0.1%	-0.1%	-0.1%
breakfast_untracked	No overlap	No overlap	No overlap
breakdance_untracked	-0.1%	0.0%	0.0%
bartender_tracked	-0.3%	-0.4%	-0.1%
cinema_tracked	0.0%	0.0%	0.0%
breakfast_tracked	-0.1%	-0.1%	-0.1%
trio			
makeup			
musical			
Average	**-0.1%**	**-0.1%**	**0.0%**
Average over mandatory V-PCC sequences	**-0.1%**	**-0.1%**	**0.0%**

1F:

Sequence	BD-rate RGB-PSNR	BD-rate YUV-PSNR	BD-rate YUV-SSIM
manwithfruit_tracked	0.0%	0.0%	0.0%
lego_ferrari	-0.1%	-0.1%	-0.1%
lego_bugatti	-0.1%	-0.1%	0.0%
cricket_player	-0.1%	-0.1%	0.0%
plant	-0.1%	-0.2%	-0.1%
solo_tango_female	-0.1%	-0.1%	-0.1%
solo_tango_male	-0.2%	-0.2%	-0.1%
tango_duo	-0.1%	-0.1%	0.0%
tennis_player	-0.1%	-0.1%	0.0%
library	No overlap	No overlap	No overlap
flowerdance	-0.2%	-0.2%	-0.1%
gymnast	-0.2%	-0.2%	-0.1%
Average	**-0.1%**	**-0.1%**	**-0.1%**
Average over mandatory V-PCC sequences	**-0.1%**	**-0.1%**	**-0.1%**

1F:

Sequence	BD-rate RGB-PSNR	BD-rate YUV-PSNR	BD-rate YUV-SSIM
bartender_semitracked	-0.1%	-0.2%	-0.1%
cinema_semitracked	-0.2%	-0.2%	-0.2%
breakfast_semitracked	-0.1%	-0.1%	-0.2%
breakfast_untracked	-0.1%	-0.1%	0.0%
breakdance_untracked			
bartender_tracked	-0.2%	-0.2%	-0.1%
cinema_tracked	-0.1%	-0.1%	-0.1%
breakfast_tracked	-0.1%	-0.1%	-0.1%
trio			
makeup			
musical			
Average	**-0.1%**	**-0.1%**	**-0.1%**
Average over mandatory V-PCC sequences	**-0.1%**	**-0.1%**	**-0.1%**

1F

Sequence	BD-rate RGB-PSNR	BD-rate YUV-PSNR	BD-rate YUV-SSIM
manwithfruit_tracked	-0.1%	-0.1%	0.0%
lego_ferrari	No overlap	No overlap	No overlap
lego_bugatti	No overlap	No overlap	No overlap
cricket_player	No overlap	No overlap	No overlap
plant	No overlap	No overlap	No overlap
solo_tango_female	No overlap	No overlap	No overlap
solo_tango_male	No overlap	No overlap	No overlap
tango_duo	No overlap	No overlap	No overlap
tennis_player	No overlap	No overlap	No overlap
library			
flowerdance	No overlap	No overlap	No overlap
gymnast	No overlap	No overlap	No overlap
Average	**-0.1%**	**-0.1%**	**0.0%**
Average over mandatory V-PCC sequences	**-0.1%**	**-0.1%**	**0.0%**

Table 2: disabling the loop filter.

5. Test 3: Enabling PCM

Anchor	Block-based sorting

1F:

Sequence	BD-rate RGB-PSNR	BD-rate YUV-PSNR	BD-rate YUV-SSIM
bartender_semitracked	-0.3%	-0.3%	0.4%
cinema_semitracked	-0.7%	-1.1%	-0.4%
breakfast_semitracked	-0.2%	-0.1%	1.1%
breakfast_untracked	No overlap	No overlap	No overlap
breakdance_untracked	0.2%	0.3%	0.2%
bartender_tracked	0.2%	-0.2%	0.1%
cinema_tracked	0.5%	0.3%	0.2%
breakfast_tracked	-0.5%	-0.2%	0.5%
trio			
makeup			
musical			
Average	**-0.1%**	**-0.2%**	**0.3%**
Average over mandatory V-PCC sequences	**-0.2%**	**-0.3%**	**0.3%**

1F

Sequence	BD-rate RGB-PSNR	BD-rate YUV-PSNR	BD-rate YUV-SSIM
bartender_semitracked	0.9%	0.5%	0.3%
cinema_semitracked	0.1%	0.2%	-0.2%
breakfast_semitracked	0.4%	0.3%	0.3%
breakfast_untracked	0.0%	0.0%	-0.6%
breakdance_untracked			
bartender_tracked	0.9%	0.8%	0.1%
cinema_tracked	0.3%	0.6%	0.1%
breakfast_tracked	0.0%	0.1%	-0.3%
trio			
makeup			
musical			
Average	**0.4%**	**0.4%**	**0.0%**
Average over mandatory V-PCC sequences	**0.4%**	**0.4%**	**0.0%**

1F

Sequence	BD-rate RGB-PSNR	BD-rate YUV-PSNR	BD-rate YUV-SSIM
manwithfruit_tracked	0.0%	0.2%	-0.6%
lego_ferrari	0.1%	0.1%	0.2%
lego_bugatti	0.1%	0.1%	0.1%
cricket_player	-0.4%	-0.4%	-0.1%
plant	0.4%	0.4%	-0.6%
solo_tango_female	-0.1%	-0.2%	-0.4%
solo_tango_male	-0.2%	-0.4%	0.1%
tango_duo	-0.3%	-0.3%	-0.1%
tennis_player	0.6%	0.6%	0.8%
library	No overlap	No overlap	No overlap
flowerdance	-0.1%	-0.1%	-0.3%
gymnast	0.4%	0.4%	1.5%
Average	**0.1%**	**0.0%**	**0.1%**
Average over mandatory V-PCC sequences	**0.1%**	**0.0%**	**0.1%**

1F

Sequence	BD-rate RGB-PSNR	BD-rate YUV-PSNR	BD-rate YUV-SSIM
manwithfruit_tracked	-0.3%	-0.2%	0.2%
lego_ferrari	No overlap	No overlap	No overlap
lego_bugatti	No overlap	No overlap	No overlap
cricket_player	No overlap	No overlap	No overlap
plant	No overlap	No overlap	No overlap
solo_tango_female	No overlap	No overlap	No overlap
solo_tango_male	No overlap	No overlap	No overlap
tango_duo	No overlap	No overlap	No overlap
tennis_player	No overlap	No overlap	No overlap
library			
flowerdance	No overlap	No overlap	No overlap
gymnast	No overlap	No overlap	No overlap
Average	**-0.3%**	**-0.2%**	**0.2%**
Average over mandatory V-PCC sequences	**-0.3%**	**-0.2%**	**0.2%**

Table 3: enabling PCM.

6. Test 4: Disabling Sample Adaptive Offset and Loop Filter, enabling PCM

Anchor	Block-based sorting

1F:

Sequence	BD-rate RGB-PSNR	BD-rate YUV-PSNR	BD-rate YUV-SSIM
bartender_semitracked	-0.7%	-1.2%	0.1%
cinema_semitracked	-0.4%	-0.1%	0.6%
breakfast_semitracked	-1.0%	-0.6%	-0.5%
breakfast_untracked	No overlap	No overlap	No overlap
breakdance_untracked	-1.0%	-1.0%	0.3%
bartender_tracked	1.0%	1.8%	2.3%
cinema_tracked	0.0%	-0.1%	0.3%
breakfast_tracked	-0.6%	-0.4%	-0.4%
trio			
makeup			
musical			
Average	**-0.4%**	**-0.2%**	**0.4%**
Average over mandatory V-PCC sequences	**-0.3%**	**-0.1%**	**0.4%**

1F:

Sequence	BD-rate RGB-PSNR	BD-rate YUV-PSNR	BD-rate YUV-SSIM
bartender_semitracked	0.7%	0.3%	0.4%
cinema_semitracked	0.0%	0.1%	-0.1%
breakfast_semitracked	0.4%	0.2%	0.3%
breakfast_untracked	-0.1%	-0.1%	-0.7%
breakdance_untracked			
bartender_tracked	0.7%	0.6%	0.0%
cinema_tracked	0.2%	0.5%	0.2%
breakfast_tracked	-0.2%	-0.1%	-0.5%
trio			
makeup			
musical			
Average	**0.2%**	**0.2%**	**-0.1%**
Average over mandatory V-PCC sequences	**0.2%**	**0.2%**	**-0.1%**

1F:

Sequence	BD-rate RGB-PSNR	BD-rate YUV-PSNR	BD-rate YUV-SSIM
manwithfruit_tracked	2.1%	1.4%	0.9%
lego_ferrari	-0.4%	-0.3%	0.8%
lego_bugatti	-0.1%	0.0%	0.7%
cricket_player	0.0%	0.2%	1.4%
plant	0.2%	0.2%	0.8%
solo_tango_female	0.2%	0.1%	0.6%
solo_tango_male	-0.4%	-0.2%	1.1%
tango_duo	0.2%	0.6%	0.7%
tennis_player	-0.1%	0.0%	1.0%
library	No overlap	No overlap	No overlap
flowerdance	-1.3%	-1.2%	-0.4%
gymnast	-0.3%	-0.3%	1.9%
Average	**0.0%**	**0.0%**	**0.9%**
Average over mandatory V-PCC sequences	**0.0%**	**0.0%**	**0.9%**

1F:

Sequence	BD-rate RGB-PSNR	BD-rate YUV-PSNR	BD-rate YUV-SSIM
manwithfruit_tracked	-0.1%	0.0%	0.8%
lego_ferrari	No overlap	No overlap	No overlap
lego_bugatti	No overlap	No overlap	No overlap
cricket_player	No overlap	No overlap	No overlap
plant	No overlap	No overlap	No overlap
solo_tango_female	No overlap	No overlap	No overlap
solo_tango_male	No overlap	No overlap	No overlap
tango_duo	No overlap	No overlap	No overlap
tennis_player	No overlap	No overlap	No overlap
library			
flowerdance	No overlap	No overlap	No overlap
gymnast	No overlap	No overlap	No overlap
Average	**-0.1%**	**0.0%**	**0.8%**
Average over mandatory V-PCC sequences	**-0.1%**	**0.0%**	**0.8%**

Table 4: disabling SAO and loop filter, enabling PCM.

7. Conclusion

7.1. Conclusions from m76215:

Variations of the encoder configurations are tested, by enabling or disabling SAO, the loop filter, and PCM. There is no obvious conclusion, due to the variability of the results over different metrics and different classes of content. Three options are on the table:

- The safest one is to disable the loop filter only. It comes with minor BD rate gains, and runtime savings.
- Disable SAO and loop filter, and enable PCM, if it is agreed to have some higher losses and some other gains depending on the content and the metric, and keep some runtime savings.
- Keep the current encoder configuration unchanged.

7.2. Conclusions from this document:

- Disabling loop filter seems to be efficient independently on the sorting method,
- Disabling SAO gives similar BD-rates, so it is safe to disable this tool,
- Enabling PCM works well for Morton sorting, but degrades coding efficiency when the block-based sorting is used.

8. References

[CTC] B. Kroon, P. Rondao Alface, J. Jung, G. Sandri, Common test conditions for Gaussian splat coding, WG7_N01414, Jan 2026.

[M76215] J. Jung, M. Karczewicz, "[GSC][VPCC][CE2.8-related] Alternative HM coding configurations for V-PCC amd.1", WG7_M76215, April 2026.

[M76580] A. Dziembowski, B. Szydełko, D. Mieloch, G. Lee, K.J. Oh, J.Y. Jeong, "[GSC][V-PCC]

[AMD1] Block-based splat sorting within raw patches”, WG7_M76580, April 2026.