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Title	CE 2.7 in TMIV 7.2
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Abstract

The adaptive texture-based pruning was proposed during the 132nd MPEG meeting [m54893]. Because of many non-Lambertian surfaces, the patches did not fit in the atlases for the case of SN sequence. The recommendation of the group was "to fix that after the meeting, and when succesful include the proposal in TMIV 7.x but leave it turned off for the MIV anchor. (To avoid schedule conflicts.) But then it is turned on for the anchor after that." [GIT]

This document presents a fix for that problem together with the results of adaptive texture-based pruning implemented in TMIV7.2.

1   Proposed fix

In adaptive texture-based pruning, the maxLumaError is multiplied by a global luma standard deviation. This standard deviation is calculated as described in section 4.8.4 of the TMIV7 document [N0005]. A low value of standard deviation results in a lower maxLumaError threshold during pruning thus a higher number of patches.

In the proposed approach, the standard deviation is calculated as described and maxLumaError is modified by multiplying by this value. Then, to provide the fix for the problems visible in SN, it is checked whether the number of non-pruned luma samples in the first frame exceeds 80% of the total area of attribute atlases. If yes, then the maxLumaError is multiplied by 1.5 and the pruning is repeated. This algorithm continues until the number of non-pruned luma samples is smaller than 80% of the atlas area or the maxLumaError is higher than its initial value (set in the configuration file).

The proposed approach is an iterative one, however, the computational time is not significantly increased, because all the iterative operations are performed only for the first frame of the sequence.

2   Experimental results

In Table 1 the results of adaptive texture-based pruning implemented in TMIV7.2 are compared to the results obtained for TMIV6. As shown, results for the majority of sequences are similar. The results were calculated for all content, full frame configuration (A97).

The highest change can be observed for SN sequence, where the fix repaired the bug of the missing part of the front knight and crown of the queen (Fig. 1). As expected, provided patch also decreases the objective bd-rate gain for SN (Table 1), because when compared to results obtained for TMIV6 (without fix), less patches with different light reflections were sent and the area of missing parts of the knight and queen's crown is much smaller, than the area of chessboard (which had more correct colors when more patches were sent).

Table 1. Adaptive texture-based pruning:
Left: TMIV6 with adaptive texture-based pruning without fix vs. TMIV6 anchor,
Right: TMIV7 with adaptive texture-based pruning with fix vs. TMIV7 anchor.

Left: Mandatory content - Proposal vs. Low/High-bitrate Anchors

Sequence		High-BR BD rate Y-PSNR	Low-BR BD rate Y-PSNR	Max delta Y-PSNR	High-BR BD rate IV-PSNR	Low-BR BD rate IV-PSNR
ClassroomVideo	SA	0.4%	0.6%	1.96	1.1%	1.0%
Museum	SB	0.5%	0.5%	16.71	0.3%	0.4%
Hijack	SC	-11.7%	5.0%	8.65	-18.0%	3.2%
Chess	SN	-37.3%	-4.9%	15.16	-25.4%	-0.3%
Kitchen	SJ	-20.4%	-10.8%	16.47	-18.7%	-10.5%
Painter	SD	3.2%	5.2%	8.01	4.1%	5.6%
Frog	SE	-5.5%	-8.3%	6.21	-7.4%	-9.4%
Carpark	SP	-0.7%	0.0%	7.46	0.0%	0.3%
MIV		-8.9%	-1.6%	10.08	-8.0%	-1.2%

Left: Optional content - Proposal vs. Low/High-bitrate Anchors

Sequence		High-BR BD rate Y-PSNR	Low-BR BD rate Y-PSNR	Max delta Y-PSNR	High-BR BD rate IV-PSNR	Low-BR BD rate IV-PSNR
Fencing	SL	-16.8%	-5.3%	12.86	-6.9%	-0.7%
Hall	ST	-34.4%	-12.4%	10.57	-10.9%	1.4%
Street	SU	-9.4%	-2.8%	10.56	-7.9%	-2.6%
Group	SR	-1.6%	-2.4%	11.91	-2.4%	-2.8%
Fan	SO	0.2%	-0.1%	9.09	-0.3%	-0.5%
MIV		-12.4%	-4.6%	11.00	-5.7%	-1.0%

Right: Mandatory content - Proposal vs. Low/High-bitrate Anchors

Sequence		High-BR BD rate Y-PSNR	Low-BR BD rate Y-PSNR	Max delta Y-PSNR	High-BR BD rate IV-PSNR	Low-BR BD rate IV-PSNR
ClassroomVideo	SA	-1.9%	1.7%	1.71	1.8%	2.8%
Museum	SB	0.5%	0.8%	16.78	0.5%	0.8%
Hijack	SC	-14.3%	-2.5%	8.83	-10.5%	-0.3%
Chess	SN	-14.7%	-10.3%	15.47	-10.7%	-9.3%
Kitchen	SJ	-6.3%	0.2%	15.63	-2.8%	1.3%
Painter	SD	1.1%	1.7%	7.84	1.4%	1.9%
Frog	SE	-0.5%	-1.2%	5.36	-1.6%	-1.7%
Carpark	SP	-3.9%	-1.8%	6.76	-1.6%	-0.8%
MIV		-5.0%	-1.4%	9.80	-2.9%	-0.7%

Right: Optional content - Proposal vs. Low/High-bitrate Anchors

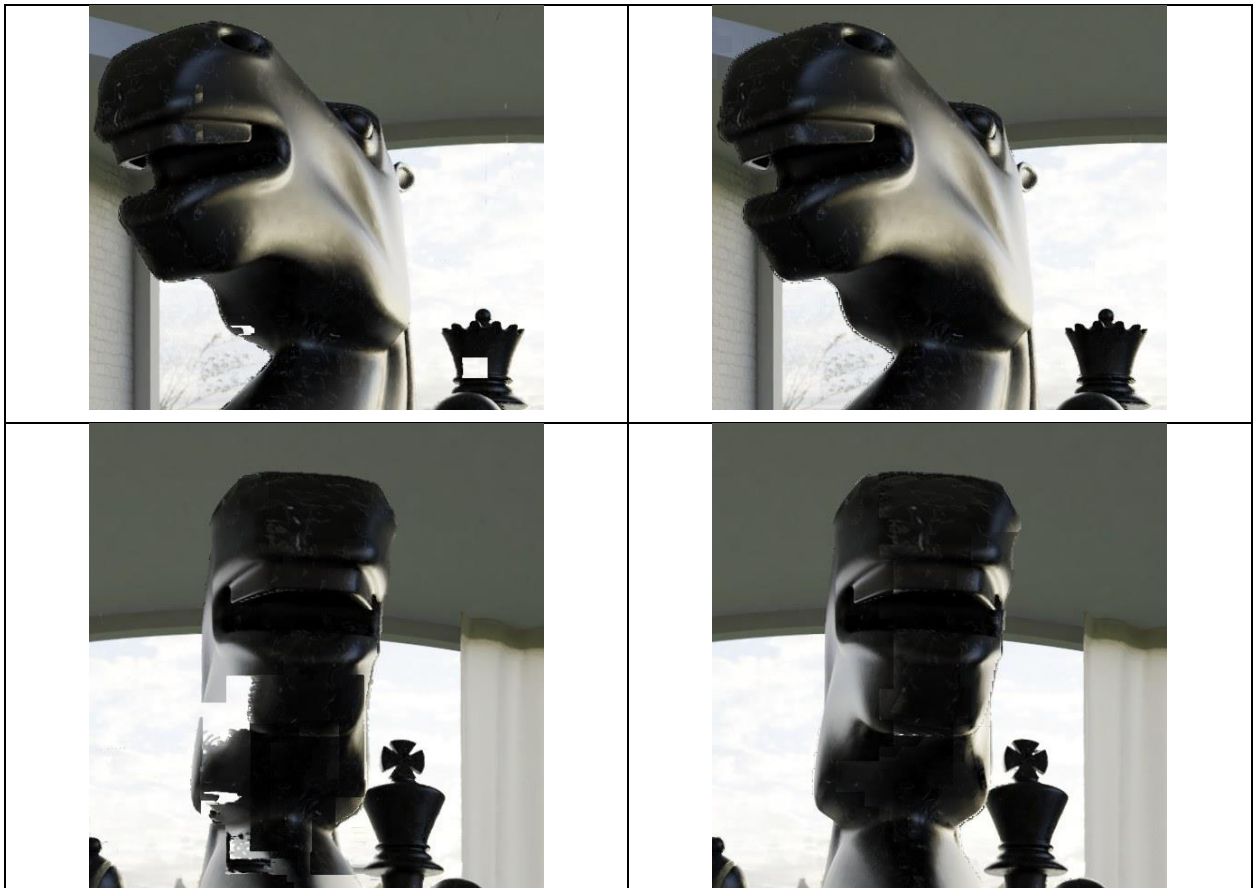| Sequence		High-BR BD rate Y-PSNR	Low-BR BD rate Y-PSNR	Max delta Y-PSNR	High-BR BD rate IV-PSNR	Low-BR BD rate IV-PSNR
Fencing	SL	-17.3%	-7.0%	9.63	-6.9%	-1.8%
Hall	ST	-20.0%	-8.5%	10.47	-9.4%	-1.9%
Street	SU	-8.7%	-3.1%	8.30	-9.8%	-4.0%
Group	SR	4.5%	3.0%	19.74	4.8%	0.8%
Fan	SO	-0.1%	0.1%	6.73	-0.0%	0.2%
MIV		-8.3%	-3.1%	10.97	-4.3%	-1.4%

Fig. 1. Fragments of two views of SN sequence without fix (left) and with proposed fix (right).

3   Recommendations

There are no recommendations, this is an informative contribution.

4   References

[GIT]   http://mpegx.int-evry.fr/software/MPEG/MIV/InputDocuments/-/issues/71#note_15746
[N0005]   "Test Model 7 for MPEG Immersive Video",
              ISO/IEC JTC1/SC29/WG4/N0005, Oct. 2020, Online.
[m54893]   D. Mieloch, A. Dziembowski, M. Domański, "MIV CE2.7: Adaptive texture-based pruning",
              ISO/IEC JTC1/SC29/WG4/m54893, Oct. 2020, Online.

5   Acknowledgement