INTERNATIONAL ORGANIZATION FOR STANDARDIZATION
ORGANISATION INTERNATIONALE DE NORMALISATION
ISO/IEC JTC 1/SC 29/WG 04 MPEG VIDEO CODING

ISO/IEC JTC 1/SC 29/WG 04 m64510

July 2023, Geneva, Switzerland

Title **[MIV] Encoder-side filtration of patch margins**

Source **PUT, ETRI**

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Abstract

This late document presents an advantage of patch margin signalling [m64165] – possibility of modification of the outer part of patches. The results of two experiments are reported. In the first one, patch boundaries in texture atlases are filtered. In the second experiment, both texture and geometry are modified. The recommendation is to include proposed filtration into TMIV17, and to start a CE on more efficient filtration techniques.

1 Proposal

In [m64165], we proposed to center a cluster within a patch and to signal the size of the margin (Fig. 1A). In this document, we present the results of filtering of the outer part of each patch (Fig. 2A).

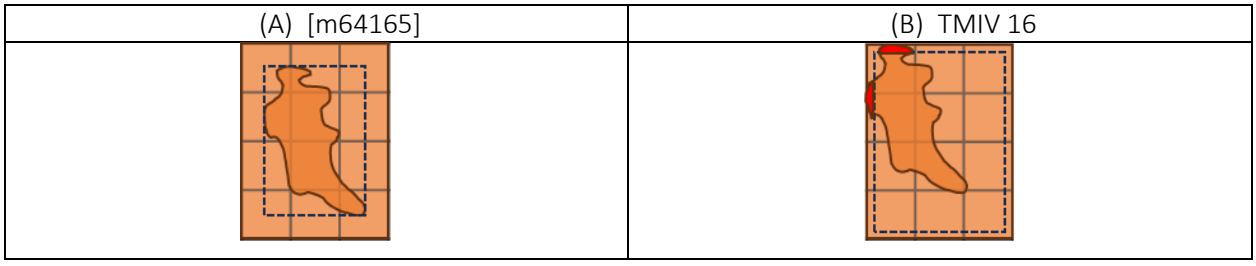


Fig. 1. Cluster within a patch in both approaches; dashed line: patch margin, areas not used in rendering; red area: valid information not used in rendering.

In the proposed filtration approach, all patch boundaries are marked as holes and inpainted using an iterative inpainting method. In the first iteration, all the empty pixels which have non-empty neighbors in a 3x3 window are filled (by averaging the value from the neighborhood). Next, the window is increased to 5x5, and the second iteration is executed. The window size is increased until reaching the size of 63x63.

In the second step, all the inpainted pixels are locally averaged once again in order to obtain smoother transitions within the inpainted area.

Such an approach allows to preserve sharp edges close to the clusters and to blur further areas.

We have tested two approaches: A – filtration of texture only, B – filtration of texture and geometry.

Fig. 2A. Proposal

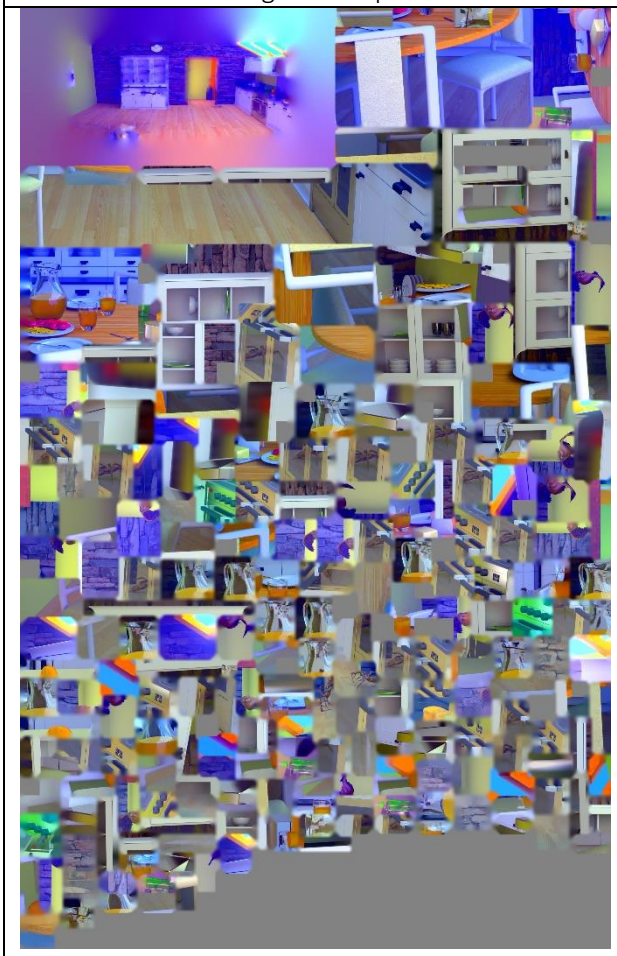
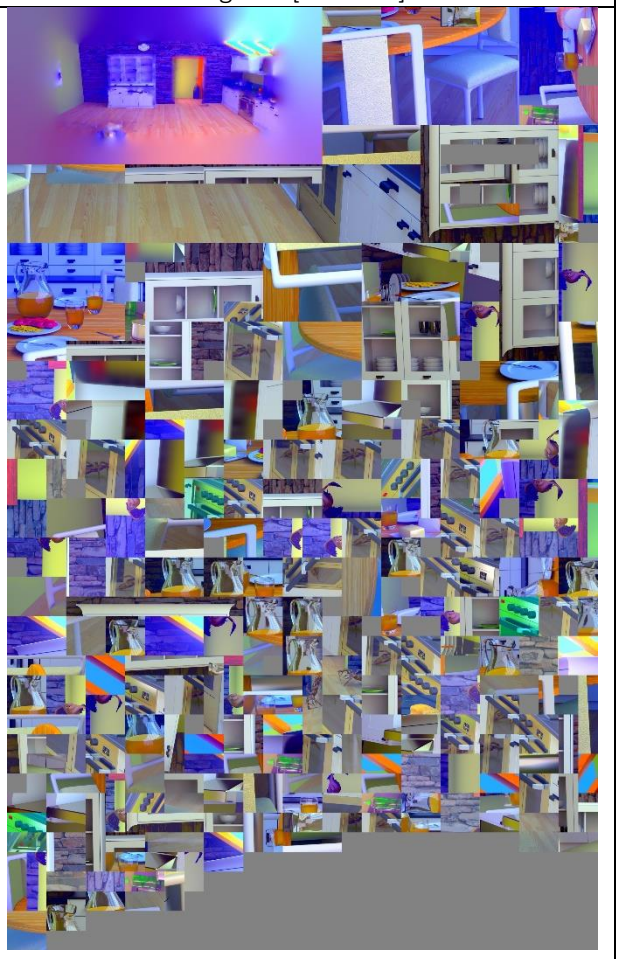


Fig. 2B. [m64165]



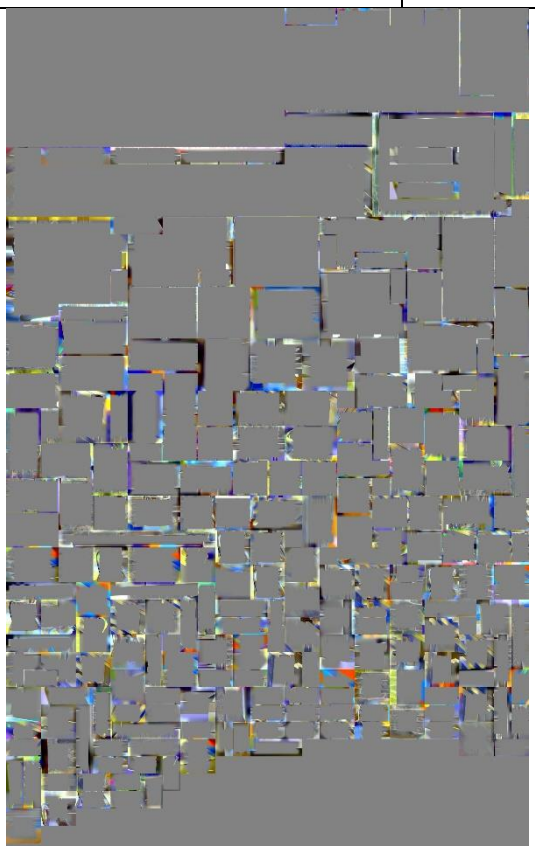


Fig. 2C. A/B difference

2 Results (A65)

2.1. [m64165] vs. texture filtration

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

Sequence		BD-rate Y-PSNR	BD-rate IV-PSNR	BD-PSNR Y-PSNR	BD-PSNR IV-PSNR
Chess	B02	-33.1%	-28.1%	1.5%	1.1%
Guitarist	B03	-27.8%	-17.0%	0.2%	0.2%
Cadillac	J02	-2.0%	-0.9%	0.1%	0.1%
Fan	J04	-1.7%	-1.3%	0.2%	0.2%
Group	W01	-10.0%	-8.7%	0.5%	0.7%
Painter	D01	-1.9%	-0.7%	0.2%	0.1%
Frog	E01	-1.4%	-0.5%	0.1%	0.1%
CBABasketball	L02	-14.0%	-9.8%	0.4%	0.3%
Average		**-11.5%**	**-8.4%**	**0.4%**	**0.3%**

Class A

Sequence		BD-rate Y-PSNR	BD-rate IV-PSNR	BD-PSNR Y-PSNR	BD-PSNR IV-PSNR
ClassroomVideo	A01	-3.5%	-3.2%	0.1%	0.2%
Average		**-3.5%**	**-3.2%**	**0.1%**	**0.2%**

Class B

Sequence		BD-rate Y-PSNR	BD-rate IV-PSNR	BD-PSNR Y-PSNR	BD-PSNR IV-PSNR
Museum	B01	-5.6%	-4.1%	0.4%	0.4%
Chess	B02	-33.1%	-28.1%	1.5%	1.1%
Guitarist	B03	-27.8%	-17.0%	0.2%	0.2%
Average		**-22.2%**	**-16.4%**	**0.7%**	**0.5%**

Class C

Sequence		BD-rate Y-PSNR	BD-rate IV-PSNR	BD-PSNR Y-PSNR	BD-PSNR IV-PSNR
Hijack	C01	-11.4%	-11.7%	0.8%	0.6%
Cyberpunk	C02	---	---	-5.8%	-6.2%
Average		**---**	**---**	**-2.5%**	**-2.8%**

a bug here

Class J

Sequence		BD-rate Y-PSNR	BD-rate IV-PSNR	BD-PSNR Y-PSNR	BD-PSNR IV-PSNR
Kitchen	J01	-10.8%	-11.1%	0.3%	0.3%
Cadillac	J02	-2.0%	-0.9%	0.1%	0.1%
Mirror	J03	-11.0%	-12.1%	1.0%	1.0%
Fan	J04	-1.7%	-1.3%	0.2%	0.2%
Average		**-6.4%**	**-6.4%**	**0.4%**	**0.4%**

Class W

Sequence		BD-rate Y-PSNR	BD-rate IV-PSNR	BD-PSNR Y-PSNR	BD-PSNR IV-PSNR
Group	W01	-10.0%	-8.7%	0.5%	0.7%
Dancing	W02	-32.6%	-40.0%	1.2%	1.7%
Average		**-21.3%**	**-24.4%**	**0.8%**	**1.2%**

Class D

Sequence		BD-rate Y-PSNR	BD-rate IV-PSNR	BD-PSNR Y-PSNR	BD-PSNR IV-PSNR
Painter	D01	-1.9%	-0.7%	0.2%	0.1%
Breakfast	D02	-16.5%	-12.1%	0.7%	0.4%
Barn	D03	-10.4%	-10.4%	0.3%	0.3%
Average		**-9.6%**	**-7.7%**	**0.4%**	**0.3%**

Class E

Sequence		BD-rate Y-PSNR	BD-rate IV-PSNR	BD-PSNR Y-PSNR	BD-PSNR IV-PSNR
Frog	E01	-1.4%	-0.5%	0.1%	0.1%
Carpark	E02	-2.9%	-2.1%	0.1%	0.1%
Street	E03	-7.3%	-5.1%	0.2%	0.1%
Average		**-3.9%**	**-2.6%**	**0.1%**	**0.1%**

Class L

Sequence		BD-rate Y-PSNR	BD-rate IV-PSNR	BD-PSNR Y-PSNR	BD-PSNR IV-PSNR
Fencing	L01	-6.5%	-4.1%	0.5%	0.2%
CBABasketball	L02	-14.0%	-9.8%	0.4%	0.3%
MartialArts	L03	-8.0%	-6.4%	0.2%	0.1%
Average		**-9.5%**	**-6.7%**	**0.3%**	**0.2%**

In general, proposed filtration decreases the total bitrate by 5% for RP1, 4% for RP2, 3% for RP3, and 2% for RP1. The quality of synthesized views is similar when compared to [m64165], both for synthesized input views and posetraces.

The posetraces are available at the MPEG content server.

2.2. Texture + depth filtration vs. texture filtration

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

Sequence		BD-rate Y-PSNR	BD-rate IV-PSNR	BD-PSNR Y-PSNR	BD-PSNR IV-PSNR
Chess	B02	-6.7%	-5.3%	0.1%	0.0%
Guitarist	B03	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Cadillac	J02	-1.0%	-0.0%	0.0%	0.0%
Fan	J04	11.8%	14.2%	-0.8%	-1.0%
Group	W01	-7.8%	-2.5%	0.4%	0.2%
Painter	D01	5.6%	5.5%	-0.2%	-0.2%
Frog	E01	0.6%	0.6%	-0.0%	-0.0%
CBABasketball	L02	3.4%	3.3%	-0.0%	-0.1%
Average		######	######	######	######

Class A

Sequence		BD-rate Y-PSNR	BD-rate IV-PSNR	BD-PSNR Y-PSNR	BD-PSNR IV-PSNR
ClassroomVideo	A01	-3.3%	-3.5%	0.0%	0.1%
Average		**-3.3%**	**-3.5%**	**0.0%**	**0.1%**

Class B

Sequence		BD-rate Y-PSNR	BD-rate IV-PSNR	BD-PSNR Y-PSNR	BD-PSNR IV-PSNR
Museum	B01	-1.1%	-0.6%	0.1%	0.0%
Chess	B02	-6.7%	-5.3%	0.1%	0.0%
Guitarist	B03	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Average		######	######	######	######

Class C

Sequence		BD-rate Y-PSNR	BD-rate IV-PSNR	BD-PSNR Y-PSNR	BD-PSNR IV-PSNR
Hijack	C01	-4.1%	-3.8%	0.1%	0.1%
Cyberpunk	C02	---	---	3.5%	3.3%
Average		**---**	**---**	**1.8%**	**1.7%**

Class J

Sequence		BD-rate Y-PSNR	BD-rate IV-PSNR	BD-PSNR Y-PSNR	BD-PSNR IV-PSNR
Kitchen	J01	-4.4%	-2.8%	0.1%	0.0%
Cadillac	J02	-1.0%	-0.0%	0.0%	0.0%
Mirror	J03	1.8%	2.0%	-0.1%	-0.1%
Fan	J04	11.8%	14.2%	-0.8%	-1.0%
Average		**2.1%**	**3.3%**	**-0.2%**	**-0.2%**

Class W

Sequence		BD-rate Y-PSNR	BD-rate IV-PSNR	BD-PSNR Y-PSNR	BD-PSNR IV-PSNR
Group	W01	-7.8%	-2.5%	0.4%	0.2%
Dancing	W02	-0.9%	1.7%	0.0%	-0.0%
Average		**-4.3%**	**-0.4%**	**0.2%**	**0.1%**

Class D

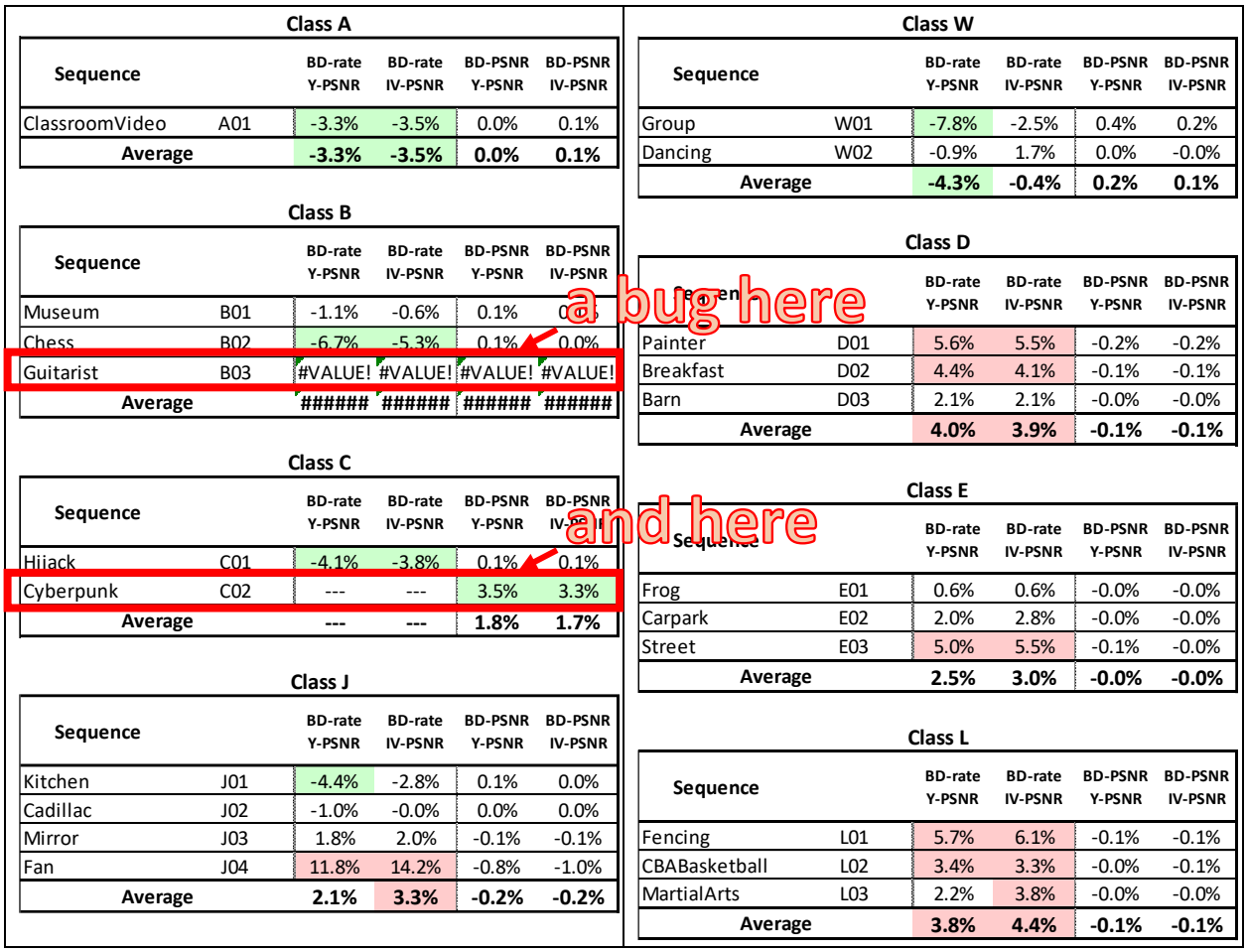
Sequence		BD-rate Y-PSNR	BD-rate IV-PSNR	BD-PSNR Y-PSNR	BD-PSNR IV-PSNR
Painter	D01	5.6%	5.5%	-0.2%	-0.2%
Breakfast	D02	4.4%	4.1%	-0.1%	-0.1%
Barn	D03	2.1%	2.1%	-0.0%	-0.0%
Average		**4.0%**	**3.9%**	**-0.1%**	**-0.1%**

Class E

Sequence		BD-rate Y-PSNR	BD-rate IV-PSNR	BD-PSNR Y-PSNR	BD-PSNR IV-PSNR
Frog	E01	0.6%	0.6%	-0.0%	-0.0%
Carpark	E02	2.0%	2.8%	-0.0%	-0.0%
Street	E03	5.0%	5.5%	-0.1%	-0.0%
Average		**2.5%**	**3.0%**	**-0.0%**	**-0.0%**

Class L

Sequence		BD-rate Y-PSNR	BD-rate IV-PSNR	BD-PSNR Y-PSNR	BD-PSNR IV-PSNR
Fencing	L01	5.7%	6.1%	-0.1%	-0.1%
CBABasketball	L02	3.4%	3.3%	-0.0%	-0.1%
MartialArts	L03	2.2%	3.8%	-0.0%	-0.0%
Average		**3.8%**	**4.4%**	**-0.1%**	**-0.1%**



Geometry filtration is efficient for natural content (positive BD-rates in tables above). For CG content, it is better to filter only the texture.

Bitrate change when using depth+texture filtering:

- CG content (classes A, B, C, W, J01, and J02): 0.9%, 1.5%, 1.9%, 0.1% (for RP1, RP2, RP3 & RP4),
- NC (classes D, E, L, J03): -1.4%, -1.8%, -2.4%, -4.0%.

Remarks:

- J03 (Mirror) was considered as NC, as depth quality for this sequence is considered low,
- J04 (Fan) was not included in average calculation, as it is an outlier (because of fine geometry).

3 Recommendation

We recommend to include proposed filtration into TMIV17, and to start a CE on more efficient filtration techniques.

4 Acknowledgement

This work was supported by Institute of Information & Communications Technology Planning & Evaluation (IITP) grant funded by the Korea government (MSIT) (No. 2018-0-00207, Immersive Media Research Laboratory).