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Source	**Poznań University of Technology (PUT), Poznań, Poland**
Status	**Input**
Title	**MIV CE2.7: Adaptive texture-based pruning**
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1 Introduction

This document presents a technical description of the continued PUT experiment on a texture-based pruning (MPEG Immersive Video CE2.7) [M54177]. In the proposed solution, the pruning color threshold adapts to sequence characteristics.

2 Proposed technique

In TMIV6, pruning is based on depth and texture information. Depth is analyzed in a pixel-to-pixel way. Color information is analyzed as a pixel-to-block comparison (Fig. 1). In this example, a pixel from view v0 is reprojected to v1. Depth similarity is being checked only for the colocated pixel (dark blue). The color of pixel marked in orange is compared to the color of all pixels in the 3×3 neighborhood of the colocated one. If the minimum error within a block is lower than the maxLumaError (and abs(depthError) < maxDepthError), the pixel of view v1 is being pruned. Otherwise, it is preserved. The maxLumaError parameter for all the sequences is the same: 0.04 (value set in configuration .json file).

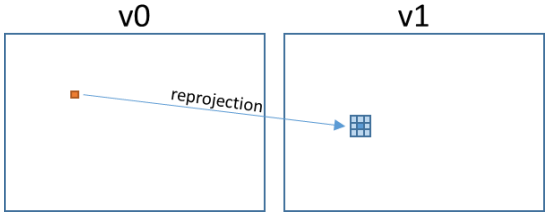

Fig. 1. The idea of color-aware block-based pruning.

In this document, we propose an enhancement to the pruning method, which allows adapting to sequence characteristics. At first, the maxLumaError should be increased for noisy sequences in order to reduce redundancy in atlases. Secondly, for sequences with negligible noise, maxLumaError should be smaller what would allow preserving also fragments of the scene with slight lighting inconsistencies.

In the proposed solution, the maxLumaError is multiplied by a global luma standard deviation. The standard deviation is calculated for the first frame of the sequence, during the depthQualityAssessment step. This value is calculated as a standard deviation of a set *A*, containing luma differences calculated for a subset of pixels.

In order to populate the set *A*, first of all, all pixels are reprojected between all pairs of input views. For each pixel, the luma of the pixel is compared with the luma of all pixels in the 3×3 neighborhood of the colocated one. If the smallest difference is 0, the luma difference between the reprojected pixel and the center of the co-located block is being included into the set *A*.

3 Experimental results

Table 1. Objective evaluation of proposed technique.

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 VMAF	Low-BR BD rate VMAF	High-BR BD rate IV-PSNR	Low-BR BD rate IV-PSNR
ClassroomVideo	SA	0.4%	0.6%	1.96	0.3%	0.6%	1.1%	1.0%
Museum	SB	0.5%	0.5%	16.71	0.2%	0.3%	0.3%	0.4%
Hijack	SC	-11.7%	5.0%	8.65	7.3%	14.2%	-18.0%	3.2%
Chess	SN	-37.3%	-4.9%	15.16	-16.3%	10.5%	-25.4%	-0.3%
Kitchen	SJ	-20.4%	-10.8%	16.47	-23.0%	-9.2%	-18.7%	-10.5%
Painter	SD	3.2%	5.2%	8.01	5.9%	6.8%	4.1%	5.6%
Frog	SE	-5.5%	-8.3%	6.21	-8.0%	-9.5%	-7.4%	-9.4%
Carpark	SP	-0.7%	0.0%	7.46	-0.7%	0.1%	0.0%	0.3%
MIV		**-8.9%**	**-1.6%**	**10.08**	**-4.3%**	**1.7%**	**-8.0%**	**-1.2%**

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

Fencing	SL	-16.8%	-5.3%	12.86	-3.8%	0.6%	-6.9%	-0.7%
Hall	ST	-34.4%	-12.4%	10.57	-15.4%	-2.4%	-10.9%	1.4%
Street	SU	-9.4%	-2.8%	10.56	-4.0%	-0.3%	-7.9%	-2.6%
Group	SR	-1.6%	-2.4%	11.91	-1.5%	-2.7%	-2.4%	-2.8%
Fan	SO	0.2%	-0.1%	9.09	-0.4%	-0.5%	-0.3%	-0.5%
MIV		**-12.4%**	**-4.6%**	**11.00**	**-5.0%**	**-1.1%**	**-5.7%**	**-1.0%**

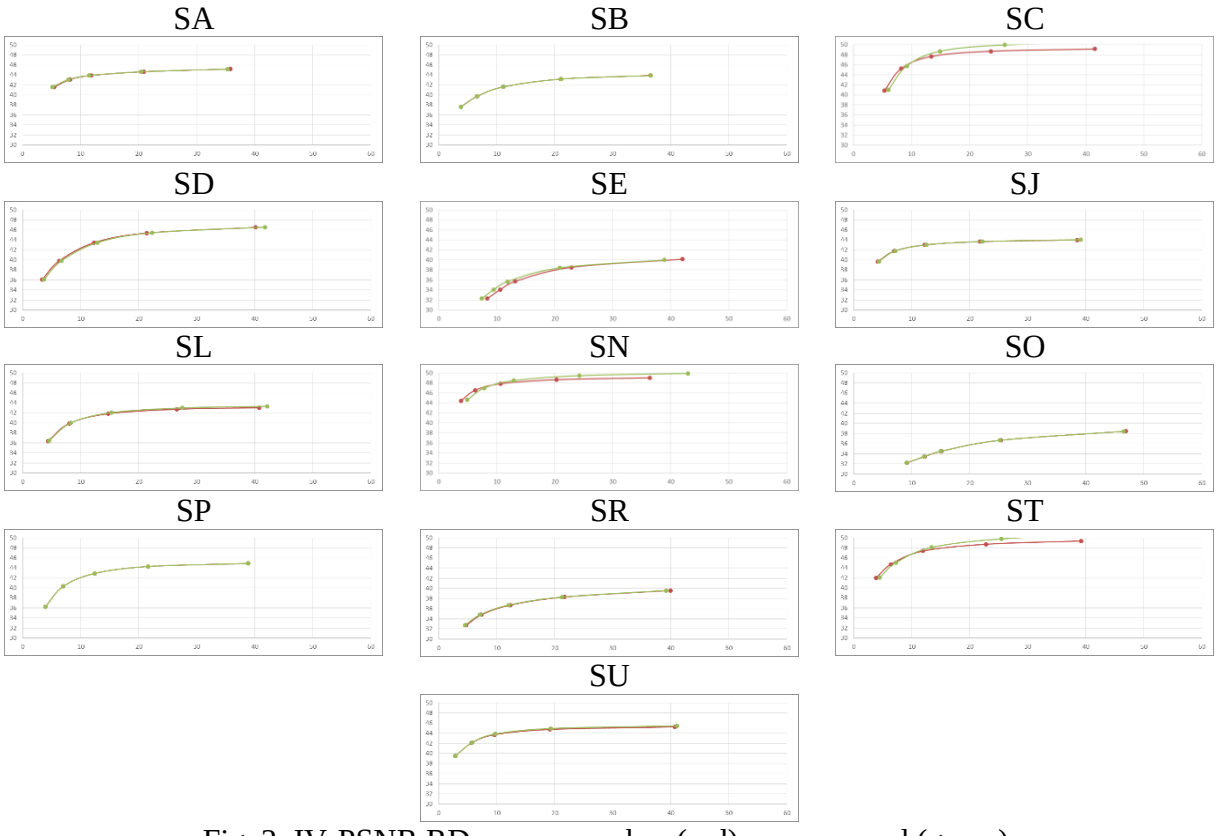

Fig. 2. IV-PSNR RD-curves: anchor (red) vs. proposed (green).

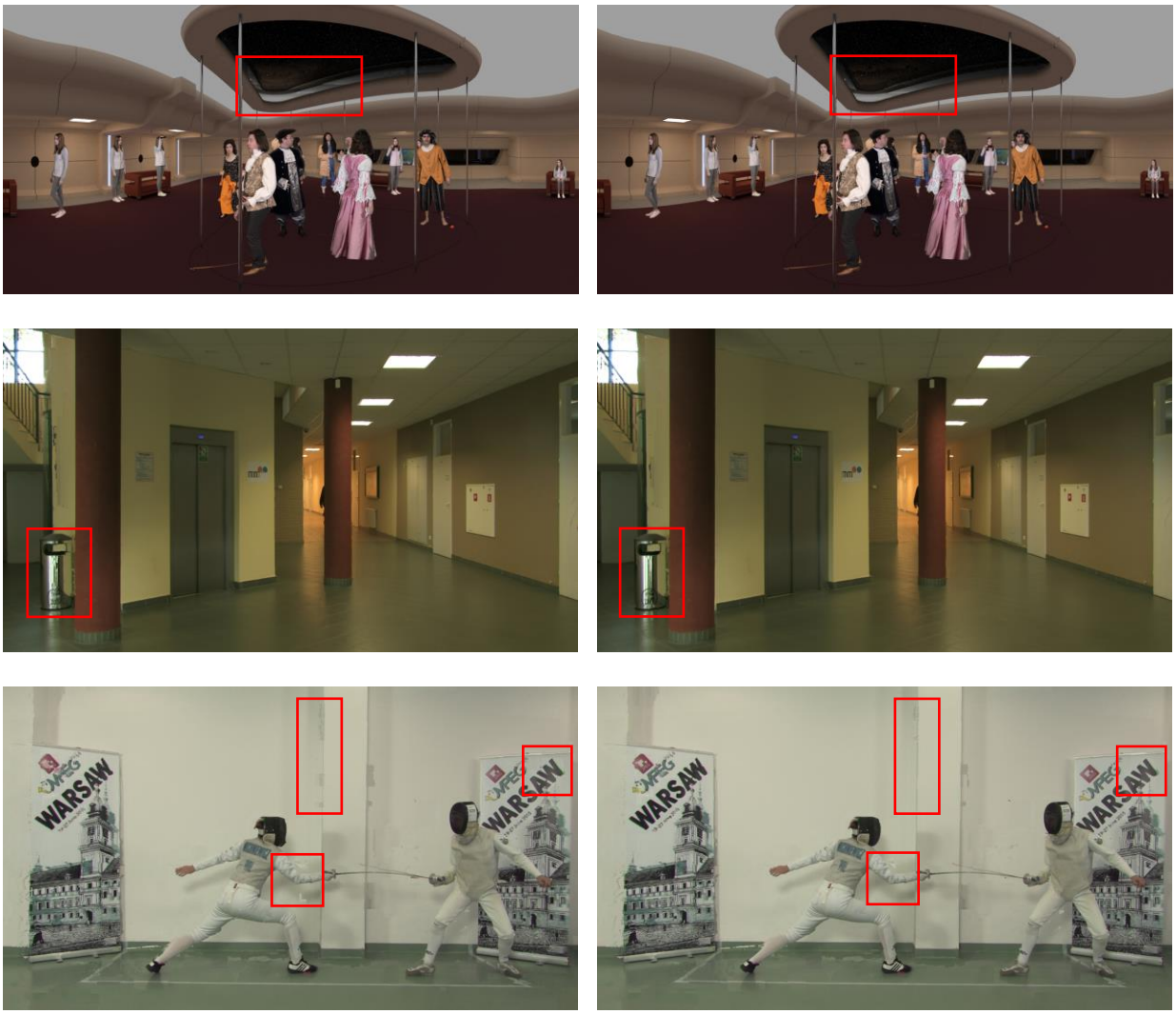

Fig. 3. Views synthesized using TMIV6.0.1 (left) vs. proposal (right).

Table 2. Pruning luma threshold values for different sequences (TMIV6.0.1 maxLumaError value: 0.04).

Sequence	**Calculated stdev**	**Modified maxLumaError**	**Calculated luma threshold for 10 bps video**
SA	0.9555	0.0382	39
SB	0.8711	0.0348	36
SC	0.2084	0.0083	9
SD	0.5670	0.0227	23
SE	1.6505	0.0660	68
SJ	0.8698	0.0348	36
SL	0.8132	0.0325	33
SN	0.3891	0.0156	16
SO	1.0498	0.0420	43
SP	0.9337	0.0373	38
SR	1.2124	0.0485	50
ST	0.2664	0.0107	11
SU	0.8560	0.0342	35

4 Acknowledgement

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5 Recommendations

We recommend:

- to include the proposed technique into TMIV7,
- to continue the Core Experiment 2.

6 References

[M54177] D. Mieloch, A. Dziembowski, “Immersive Video CE2.7: Texture-dependent pruning”, ISO/IEC JTC1/SC29/WG11 MPEG/M54177, June 2020, Online.