INTERNATIONAL ORGANISATION FOR STANDARDISATION
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ISO/IEC JTC 1/SC 29/WG 4
MPEG VIDEO CODING

Title: **[MIV] Proposal of IVDE 8.0**
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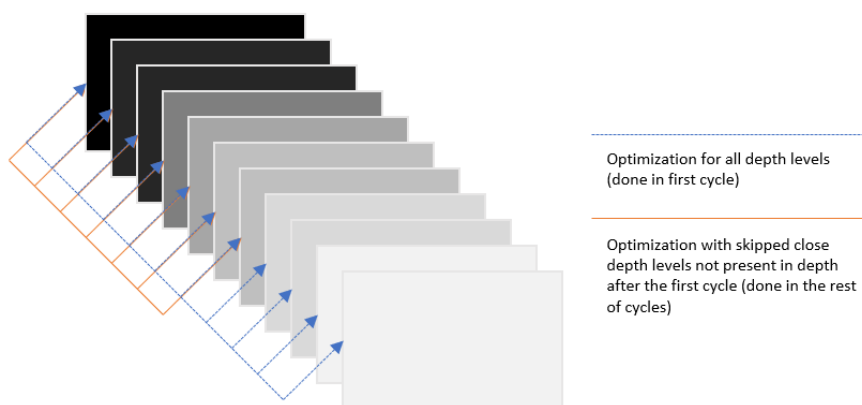   ** – Electronics and Telecommunications Research Institute

Abstract

This document presents new functionalities proposed to be included in the new version of Immersive Video Depth Estimation software. The changes are focused on faster optimization and include skipping of null optimizations and hierarchical optimization. Changes also include fixes of two errors in IVDE code. We recommend accepting the proposal as a new version of IVDE (8.0) and issuing a new manual for the software as an output document.

1 Introduction and description of the proposal

In this document, new functionalities proposed for IVDE are described. Moreover, fixes of errors discovered during the works are also listed and explained.
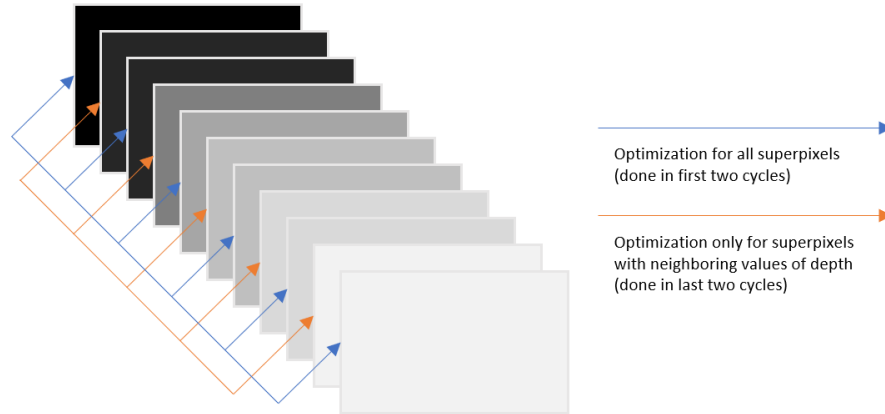
1.1 Skipping of null optimizations

The automatically computed depth range for some sequences is too wide [m55751], making optimization redundant for some levels of depth. We propose to perform optimization for all depth levels in only the first cycle, while for the latter cycles, the optimization can skip the closest depth levels which were not chosen in the first cycle. This change has negligible influence on the final depth maps quality but decreases the number of optimization steps (e.g., for Carpark, only 44% of levels are checked in the second cycle).

Optimization for all depth levels (done in first cycle)

Optimization with skipped close depth levels not present in depth after the first cycle (done in the rest of cycles)

1.2 Hierarchical optimization

We propose to perform optimization hierarchically. First of all, depth is estimated for a limited number of depth levels (e.g., for each second of 256 levels). Next, for the remaining levels, optimization is done partially, only for superpixels with neighboring depth values to the one currently being optimized. This way, these optimizations are performed much faster, as they only refine depth maps estimated in the full optimizations.

Optimization for all superpixels
(done in first two cycles)

Optimization only for superpixels
with neighboring values of depth
(done in last two cycles)

1.3 Bugfixes

- Inconsistent rounding when depth labels are converted to/from depth map values.
- Incorrect position of neighboring superpixels used in calculation of smoothing.

2 Experimental results

We compare the proposal with G65 anchor. We also propose to set the number of threads to one (done in the shown results). It decreases the amount of memory required for computations and decreases the area of temporal errors in estimated depth maps.

- "HierarchicalOptimizationStep": 4, "SkipNullOptimizations": true

Mandatory content - Proposal vs. Low/High-bitrate Anchors　　　　**Runtime ratio (%)**

Sequence		BD-rate Y-PSNR	BD-rate IV-PSNR	BD-PSNR Y-PSNR	BD-PSNR IV-PSNR	Atlas encoding	Video encoding	Decoding & Rendering
Kitchen	J01	6.8%	3.5%	-0.3%	-0.2%	100.0%	100.0%	50.3%
Group	W01	266.7%	111.3%	-1.5%	-1.1%	100.0%	100.0%	87.9%
Painter	D01	-2.5%	-2.0%	-0.1%	-0.2%	100.0%	100.0%	33.4%
Barn	D03	-15.3%	-15.1%	0.4%	0.4%	100.0%	100.0%	33.3%
Fencing	L01	273.3%	93.8%	-1.3%	-0.9%	100.0%	100.0%	32.5%
CBABasketball	L02	-7.0%	-3.5%	0.0%	0.0%	100.0%	100.0%	45.6%
Average		**87.0%**	**31.3%**	**-0.5%**	**-0.3%**	**100.0%**	**100.0%**	**47.2%**

Anchor	Proposal

- "HierarchicalOptimizationStep": 8, "SkipNullOptimizations": true

Mandatory content - Proposal vs. Low/High-bitrate Anchors   **Runtime ratio (%)**

Sequence		BD-rate Y-PSNR	BD-rate IV-PSNR	BD-PSNR Y-PSNR	BD-PSNR IV-PSNR	Atlas encoding	Video encoding	Decoding & Rendering
Kitchen	J01	10.5%	4.3%	-0.4%	-0.2%	100.0%	100.0%	34.4%
Group	W01	314.8%	119.9%	-1.6%	-1.1%	100.0%	100.0%	69.3%
Painter	D01	-6.0%	-9.3%	0.2%	0.4%	100.0%	100.0%	22.9%
Barn	D03	1.4%	-12.7%	-0.1%	0.3%	100.0%	100.0%	34.6%
Fencing	L01	513.6%	135.8%	-1.7%	-1.1%	100.0%	100.0%	19.4%
CBABasketball	L02	36.4%	32.7%	-0.3%	-0.4%	100.0%	100.0%	34.1%
Average		**145.1%**	**45.1%**	**-0.6%**	**-0.4%**	**100.0%**	**100.0%**	**35.8%**

Subjective comparison shows a similar quality of rendered pose traces, shown BD-rate differences are large due to relatively flat curves of quality/bitrate plots (Figs. below).
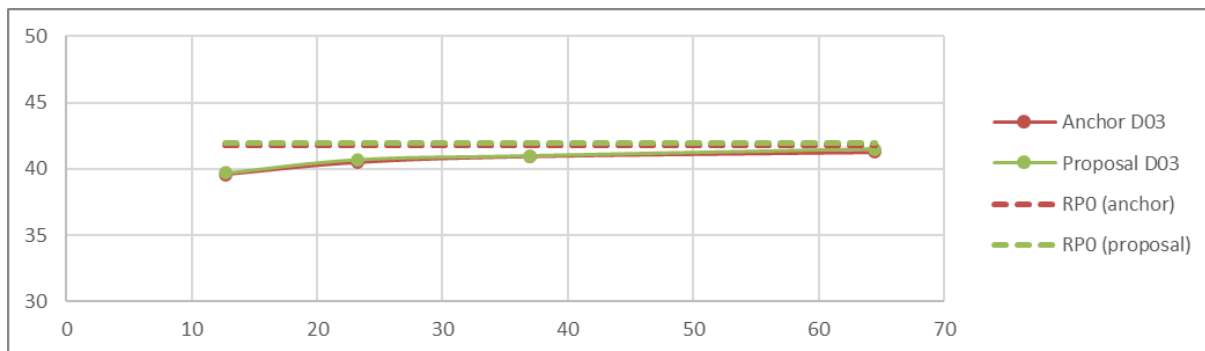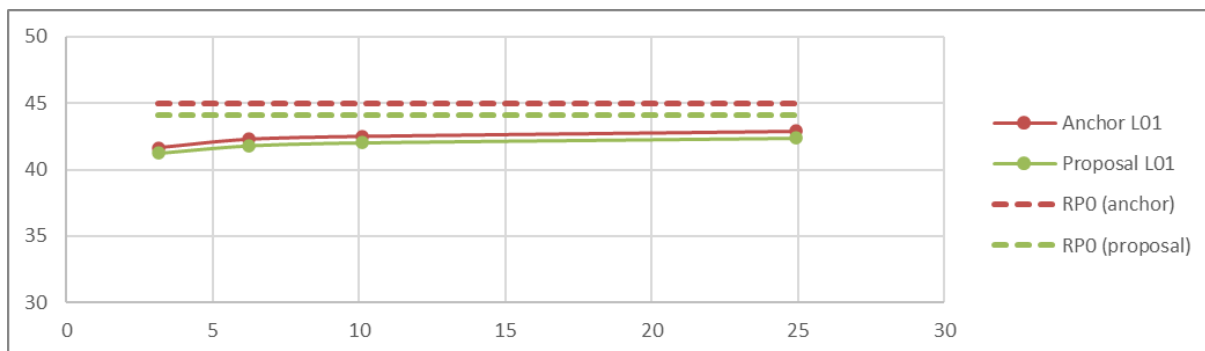
Results for all sequences are available in attached .xlsm files, pose traces will be made available upon request.

3 Recommendations

We recommend accepting the proposal as a new version of IVDE (8.0) and issuing a new manual for the software as an output document.

4 References

[m55751] D. Mieloch, A. Dziembowski, "Proposal of IVDE 3.0," ISO/IEC JTC1/SC29/WG4 doc. MPEG2020/ M55751, Online, January 2021.

5 Acknowledgement