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Title: New inter-view matching method in IVDE
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Abstract

The document describes a proposal of new inter-view matching method that increases the quality of estimated depth maps for when input views are compressed. The matching is based on the comparison of a point to the most similar point within a small block (similarly as in IV-PSNR). We recommend to:

- Include the proposal to new version of IVDE.
- Use this method in decoder-side depth estimation anchor.

1 Introduction and description of proposal

The documents a proposal of new inter-view matching method that increases the quality of estimated depth maps for when input views are compressed.

The compression can cause a (usually small) shift of the edges present in the texture. In order to reduce the influence of such errors, the proposed matching is based on the comparison of a point to the most similar point within a small block. Such concept was already presented in IV-PSNR, in which the point of a reference image is compared to the most similar point in a 5×5 block in the tested image.

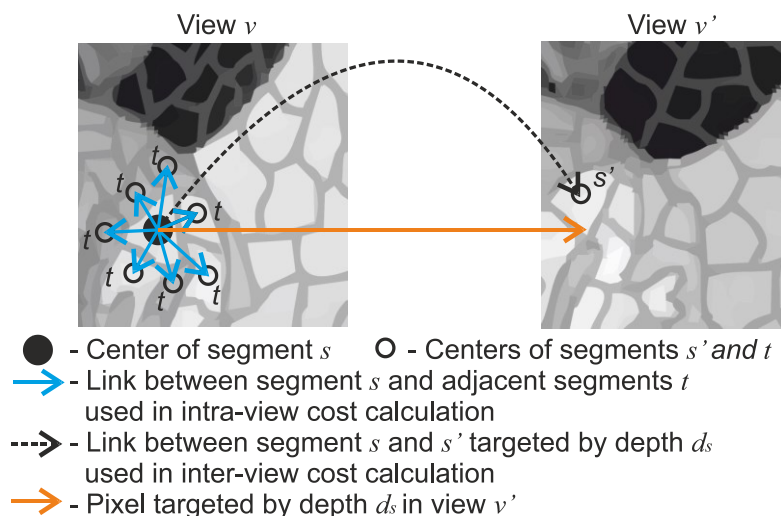


Fig. 1. Calculation of intra- and inter-view cost in IVDE.

In the IVDE, the matching of neighboring views is performed from the center of a segment s in a view v to a point in another view v' , targeted by some depth d_s (Fig. 1). In the proposal, a 3×3 neighborhood of the targeted point in view v' is searched in order to find the lowest value of the matching error.

2 Experimental results

The proposal was tested in 3 current use cases of IVDE: decoder-side depth estimation, decoder-side depth estimation with encoder-derived features, and encoder-side depth estimation.

2.1 G17 anchor (decoder-side depth estimation)

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	-41.0%	-33.9%	5.56	-32.6%	-18.5%	5.3%	3.3%
Museum	SB	-99.9%	3.2%	14.72	-15.8%	-3.3%	-23.7%	-1.8%
Fan	SO	3.4%	1.9%	10.29	2.7%	1.0%	4.1%	3.1%
Kitchen	SJ	36.6%	23.0%	13.99	65.0%	33.4%	10.5%	7.6%
Painter	SD	15.6%	9.6%	9.75	24.9%	11.7%	10.1%	6.4%
Frog	SE	0.6%	-0.2%	6.85	0.7%	0.3%	0.4%	-0.1%
Carpark	SP	-25.6%	-13.4%	9.21	-4.3%	-2.7%	-2.9%	0.4%
Chess	SN	---	---	24.45	-48.1%	-36.0%	---	-68.6%
Group	SR	-91.9%	-100.0%	22.83	13.6%	6.8%	-80.1%	-100.0%
MIV		---	---	13.07	0.7%	-0.8%	---	-16.6%

Optional content - Proposal vs. Low/High-bitrate Anchors								
Fencing	SL	-33.4%	-18.6%	12.58	5.7%	3.0%	-5.2%	-5.1%
Hall	SU	-27.4%	-15.6%	7.66	-12.5%	-6.0%	-0.6%	-0.6%
Street	ST	---	-72.7%	17.56	48.6%	12.1%	---	-99.2%
ChessPieces	SQ	---	-61.5%	29.02	-8.3%	-10.5%	-30.4%	38.4%
Hijack	SC	#####	-9.6%	22.43	-6.7%	0.3%	122.9%	-14.3%
MIV		---	-35.6%	17.85	5.3%	-0.2%	---	-16.2%

The table above shows the comparison of the G17 anchor with the proposal in the same configuration.

The proposal shows worse objective results for only two sequences: SD and SJ, however, the comparison of fragments of posetraces shows improvement of the quality in practically all sequences. The full posetraces will be available upon the request of the group.

Below, the tables with the comparison of WS-PSNR can be find. These tables show just the quality of the synthesized views, not a BD-rate (as the bitrate for the anchor and the proposal is of course the same).

SA			SB			SC		
WS-PSNR			WS-PSNR			WS-PSNR		
Anchor SA	Proposal SA	Delta	Anchor SB	Proposal SB	Delta	Anchor SC	Proposal SC	Delta
31.57	31.71	0.14	26.91	27.79	0.88	29.65	29.70	0.05
31.50	31.64	0.14	26.57	27.34	0.78	29.54	29.51	-0.03
31.33	31.45	0.12	26.82	27.05	0.23	29.53	29.63	0.10
31.21	31.35	0.14	26.59	26.54	-0.05	29.41	29.47	0.06
30.93	31.06	0.13	26.06	26.05	-0.02	29.20	29.16	-0.04
SJ			SN			SD		
WS-PSNR			WS-PSNR			WS-PSNR		
Anchor SJ	Proposal SJ	Delta	Anchor SN	Proposal SN	Delta	Anchor SD	Proposal SD	Delta
35.70	34.97	-0.73	27.83	28.49	0.67	37.68	37.24	-0.44
34.64	34.09	-0.55	27.97	28.54	0.56	37.19	36.90	-0.29
33.79	33.38	-0.41	27.91	28.59	0.68	36.43	36.26	-0.17
32.62	32.32	-0.30	27.61	28.42	0.81	35.20	34.98	-0.22
31.57	31.20	-0.37	27.84	28.22	0.38	33.55	33.41	-0.14
SE			SP			SL		
WS-PSNR			WS-PSNR			WS-PSNR		
Anchor SE	Proposal SE	Delta	Anchor SP	Proposal SP	Delta	Anchor SL	Proposal SL	Delta
31.11	31.08	-0.03	35.59	35.79	0.20	34.15	34.23	0.09
30.16	30.12	-0.03	35.38	35.64	0.27	33.98	34.08	0.10
28.74	28.74	0.00	34.95	35.16	0.21	33.90	34.00	0.11
27.26	27.28	0.02	34.43	34.55	0.12	33.74	33.83	0.09
25.54	25.55	0.02	33.53	33.64	0.11	33.24	33.33	0.09
ST			SU			SR		
WS-PSNR			WS-PSNR			WS-PSNR		
Anchor ST	Proposal ST	Delta	Anchor SU	Proposal SU	Delta	Anchor SR	Proposal SR	Delta
35.44	35.70	0.26	36.65	36.97	0.31	20.29	20.27	-0.02
35.35	35.60	0.26	36.36	36.54	0.18	20.41	20.18	-0.23
35.27	35.65	0.38	36.10	36.35	0.25	20.12	20.43	0.31
35.31	35.64	0.33	35.50	35.68	0.18	20.80	20.71	-0.09
35.27	35.31	0.04	34.42	34.59	0.17	20.10	20.63	0.52
SO			SQ					
WS-PSNR			WS-PSNR					
Anchor SO	Proposal SO	Delta	Anchor SQ	Proposal SQ	Delta			
32.17	32.10	-0.07	27.56	27.66	0.09			
31.39	31.34	-0.05	27.71	27.78	0.07			
30.47	30.41	-0.06	27.81	27.98	0.17			
29.34	29.30	-0.04	27.56	27.82	0.25			
27.76	27.79	0.04	27.50	27.60	0.11			

Classroom



Anchor



Proposal



Difference

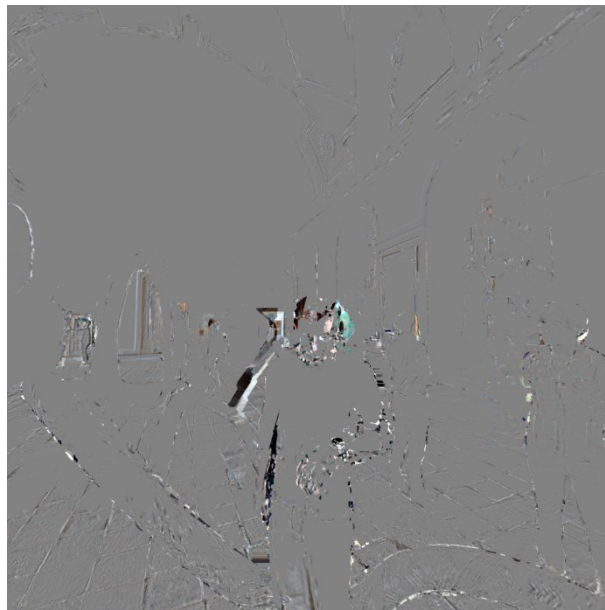
Museum



Anchor



Proposal



Difference

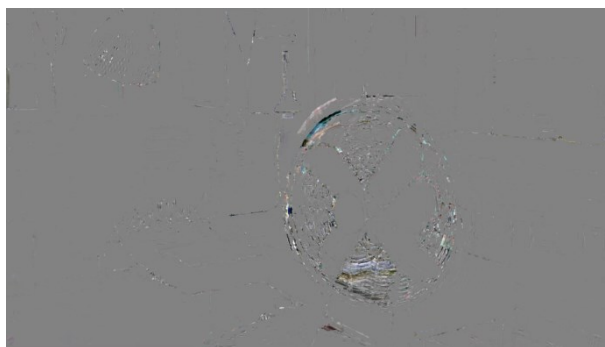
Fan



Anchor



Proposal



Difference

Kitchen



Anchor



Proposal



Difference

Painter



Anchor



Proposal



Difference

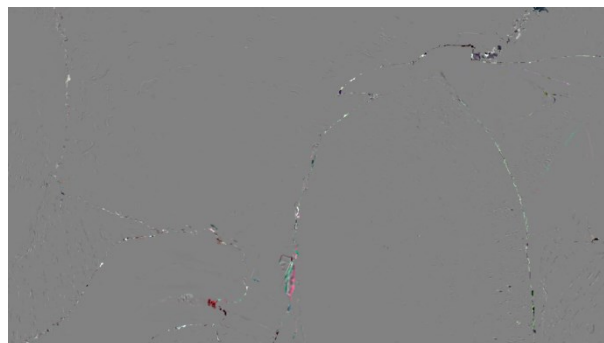
Frog



Anchor



Proposal



Difference

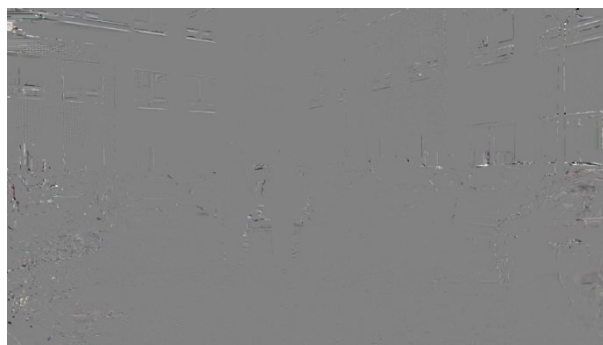
Carpark



Anchor



Proposal



Difference

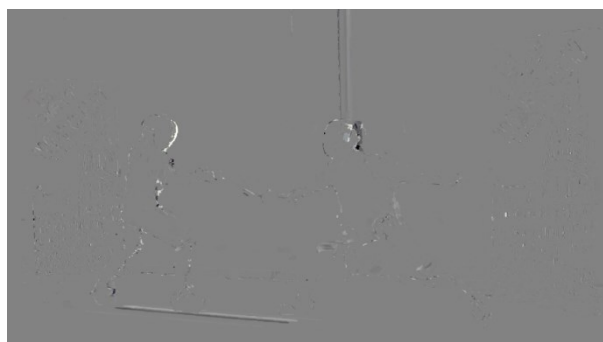
Fencing



Anchor

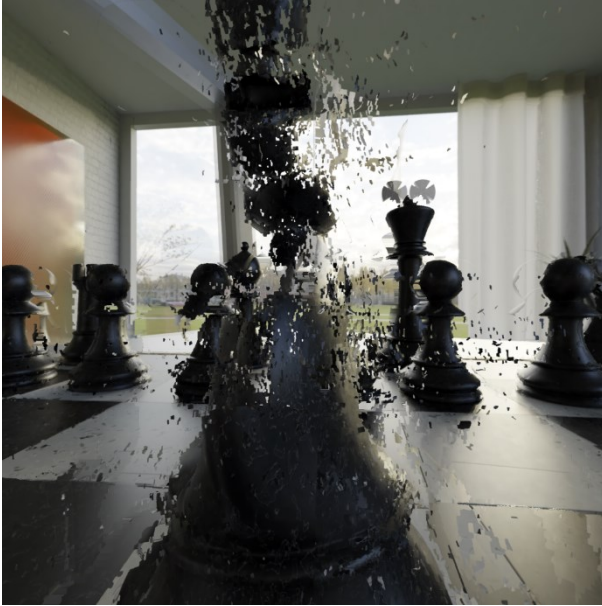


Proposal



Difference

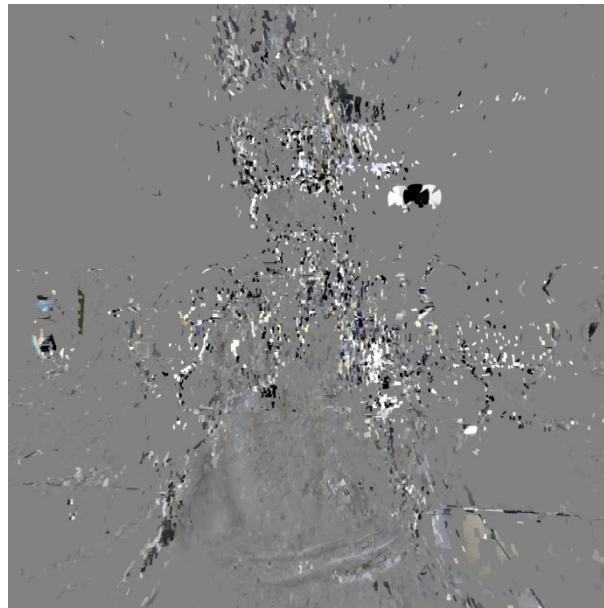
Chess



Anchor



Proposal



Difference

2.2 EE2 configuration (encoder-derived features)

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	86.7%	-0.8%	5.67	-43.3%	2.1%	17.8%	9.5%
Museum	SB	-3.3%	-3.7%	13.31	-2.9%	-2.4%	-2.3%	-1.9%
Fan	SO	-0.0%	-0.5%	10.01	2.4%	0.5%	-0.0%	-0.1%
Kitchen	SJ	24.8%	14.8%	12.91	37.4%	20.7%	2.8%	2.4%
Painter	SD	13.3%	5.2%	8.54	19.7%	7.7%	6.5%	2.7%
Frog	SE	-0.1%	-0.2%	6.54	0.6%	0.2%	-0.7%	-0.4%
Carpark	SP	-8.7%	-4.1%	9.44	-0.1%	0.2%	4.8%	3.6%
Chess	SN	-3.8%	-6.4%	23.35	-4.5%	-2.7%	-13.2%	-1.8%
Group	SR	18.2%	14.5%	18.31	1.4%	1.2%	6.9%	3.7%
MIV		14.1%	2.1%	12.01	1.2%	3.0%	2.5%	2.0%

Optional content - Proposal vs. Low/High-bitrate Anchors								
Fencing	SL	-21.7%	-12.1%	12.61	9.0%	3.7%	-0.6%	-1.0%
Hall	SU	-14.7%	-8.9%	7.92	-4.9%	-2.3%	-0.7%	-0.7%
Street	ST	---	-45.0%	16.62	25.8%	8.9%	2.7%	-11.7%
ChessPieces	SQ	---	-96.5%	30.80	-14.0%	-7.5%	-21.6%	-27.1%
Hijack	SC	36.1%	5.9%	20.89	10.2%	3.0%	-13.3%	-14.3%
MIV		---	-31.3%	17.77	5.2%	1.2%	-6.7%	-11.0%

The table above shows the comparison of the EE2 results with the proposal in the same configuration as in this EE.

The improvements and degradation of the objective quality in this case is much smaller, the proposal mainly influences sequences with CTC depth maps of lower quality. On average, the differences are small.

2.3 EE5 configuration (encoder-side depth estimation)

Mandatory content - Proposal vs. Low/High-bitrate Anchors								
Sequence		High-BR	Low-BR	Max	High-BR	Low-BR	High-BR	Low-BR
		BD rate	BD rate	delta	BD rate	BD rate	BD rate	BD rate
		Y-PSNR	Y-PSNR	Y-PSNR	VMAF	VMAF	IV-PSNR	IV-PSNR
ClassroomVideo	SA	---	8.2%	4.23	-16.4%	-40.6%	-36.4%	-40.9%
Museum	SB	---	---	24.26	46.1%	19.4%	---	---
Fan	SO	6.5%	8.6%	5.92	6.4%	8.0%	4.0%	7.8%
Kitchen	SJ	-47.1%	-40.5%	16.71	-52.4%	-43.1%	-30.5%	-29.2%
Painter	SD	27.0%	16.7%	9.02	19.0%	12.2%	26.5%	15.5%
Frog	SE	2.9%	-3.2%	7.08	-3.9%	-7.0%	-7.0%	-8.8%
Carpark	SP	-4.0%	-5.9%	7.17	-3.0%	-5.5%	-5.4%	-6.4%
Chess	SN	-56.4%	-39.1%	27.72	-49.8%	-33.1%	-9.0%	-10.9%
Group	SR	---	---	12.10	---	-54.8%	---	---
MIV		---	---	12.69	---	-16.1%	---	---

Optional content - Proposal vs. Low/High-bitrate Anchors								
Fencing	SL	21.2%	8.8%	10.04	5.8%	3.7%	-3.2%	-1.0%
Hall	SU	163.4%	14.5%	11.08	76.1%	4.4%	1.6%	-15.1%
Street	ST	13.1%	8.9%	9.88	9.2%	7.9%	8.7%	7.2%
ChessPieces	SQ	---	---	28.65	---	-41.2%	-35.3%	-18.9%
Hijack	SC	---	-77.4%	20.33	1.9%	-16.0%	---	-62.1%
MIV		---	---	16.00	---	-8.2%	---	-18.0%

The table above shows the comparison of the EE5 results with the proposal in the same configuration as in this EE.

For encoder-side depth estimation (re-estimation of CTC depth maps), the differences are much larger than in the previous configuration, but are very mixed.

3 Recommendations

We recommend to:

- Include the proposal to new version of IVDE.
- Use this method in decoder-side depth estimation anchor.

Acknowledgement

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