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Title **Freeview Navigation (FN) anchor generation using 3D-HEVC with depth for "Poznan Blocks" sequence**
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1 Introduction

This contribution provides anchor data for future Call for Evidence, according to the table from draft Call for Evidence. This document focuses on Poznan Blocks [1] sequence.

2 Anchor configuration

The test configuration is the following:
Seven views are encoded together with depth maps. The encoded views are views number 2, 3, 4, 5, 6, 7, 8. The QP values tested are the following: 25, 30, 35, 40. Corresponding QD values are the following: 34, 39, 44, 49.
Three different prediction structures were tested.

Structure I
First structure of inter-view prediction is shown on Figure 1.

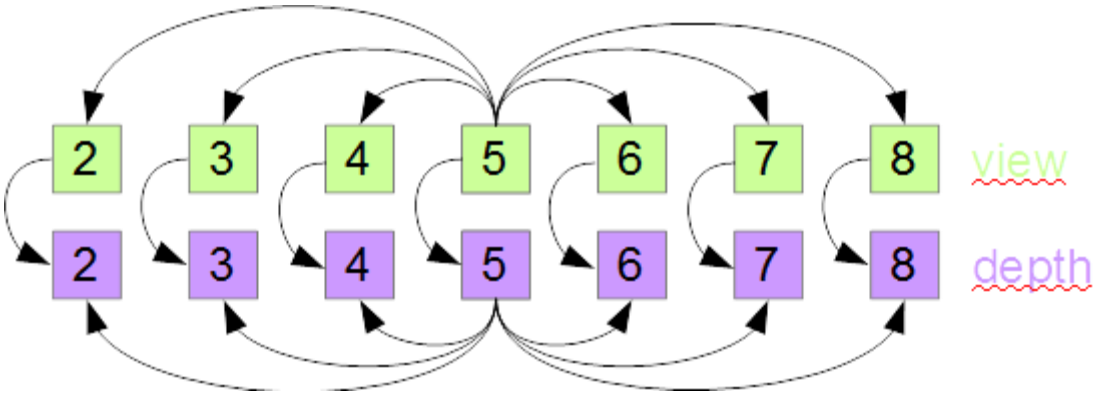


Figure 1. Inter-view prediction structure I

The bitrates and PSNR values for the structure I are given in the Table 1.

Table 1. Results for the structure I

Bitrates in kbps, PSNR in dB

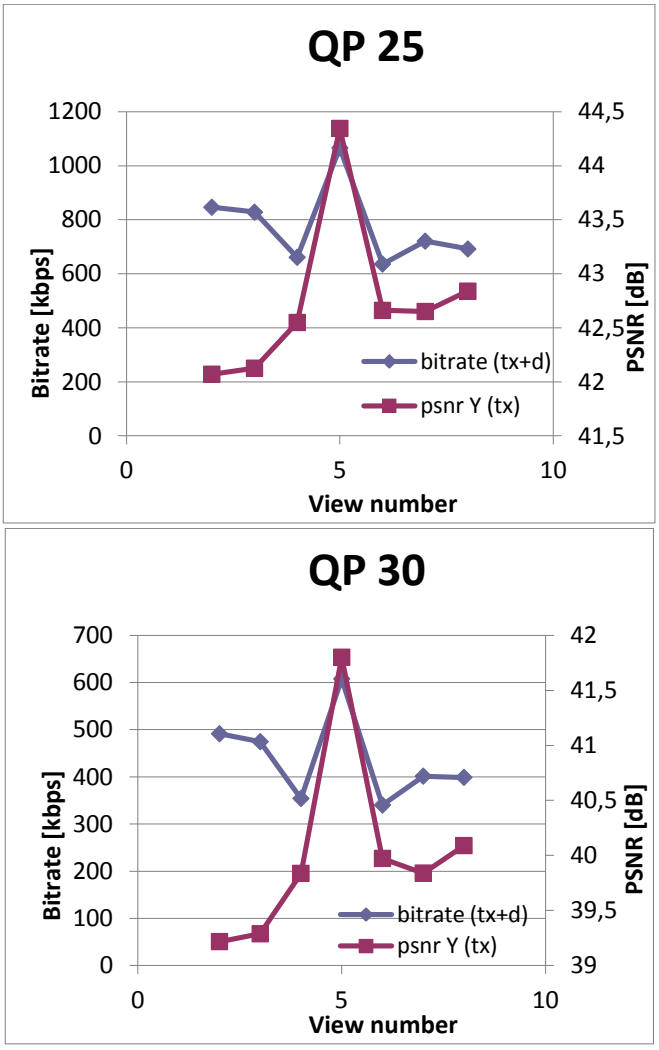
Qp 25 Qd 34				
	bitrate (tx)	psnr Y (tx)	bitrate (d)	bitrate (tx+d)
View 2	795.1896	42.0711	51.2584	846.448
View 3	780.6384	42.1263	47.6208	828.2592
View 4	614.5576	42.5498	46.5312	661.0888
View 5	1001.2552	44.3456	64.8776	1066.1328
View 6	593.96	42.6615	42.0736	636.0336
View 7	676.356	42.6515	44.5712	720.9272
View 8	642.9104	42.8397	49.088	691.9984

Qp 30 Qd 39				
	bitrate (tx)	psnr Y (tx)	bitrate (d)	bitrate (tx+d)
View 2	461.2408	39.217	29.9344	491.1752
View 3	446.0184	39.2883	28.3456	474.364
View 4	326.4872	39.8367	27.5192	354.0064
View 5	569.5408	41.8002	37.9672	607.508
View 6	314.908	39.9727	25.1376	340.0456
View 7	374.8152	39.8394	26.4592	401.2744
View 8	369.4048	40.0893	29.3392	398.744

Qp 35 Qd 44				
	bitrate (tx)	psnr Y (tx)	bitrate (d)	bitrate (tx+d)
View 2	274.1232	36.2107	18.5688	292.692
View 3	253.2944	36.3018	17.528	270.8224
View 4	183.4504	36.9976	16.8176	200.268
View 5	332.0096	38.9854	23.0904	355.1
View 6	173.0288	37.173	15.8464	188.8752
View 7	211.8544	36.9488	16.9416	228.796
View 8	218.1656	37.1626	18.3936	236.5592

Qp 40 Qd 49				
	bitrate (tx)	psnr Y (tx)	bitrate (d)	bitrate (tx+d)
View 2	155.5736	33.1678	12.5344	210.456
View 3	141.8776	33.3354	11.1936	153.0712
View 4	101.5032	34.1483	10.8896	112.3928
View 5	195.5912	36.0316	14.8648	210.456
View 6	95.5224	34.4039	10.6944	106.2168
View 7	117.6576	34.0969	11.4888	129.1464
View 8	125.5912	34.2224	12.16	137.7512

The graphs on Figure 2 show the values from Table 1 in a more convenient way.



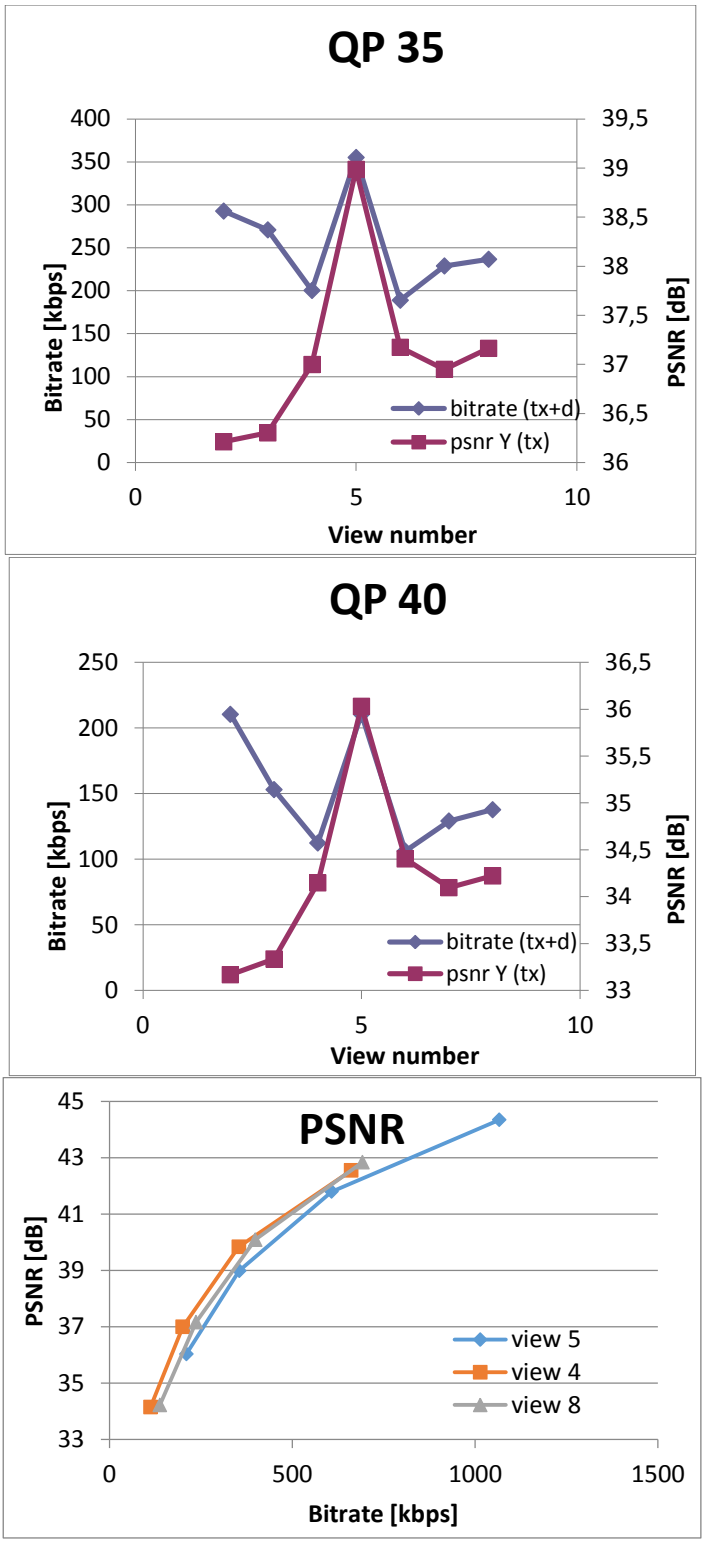


Figure 2. The results for structure I

Structure II

Second structure of inter-view prediction is shown on Figure 3.

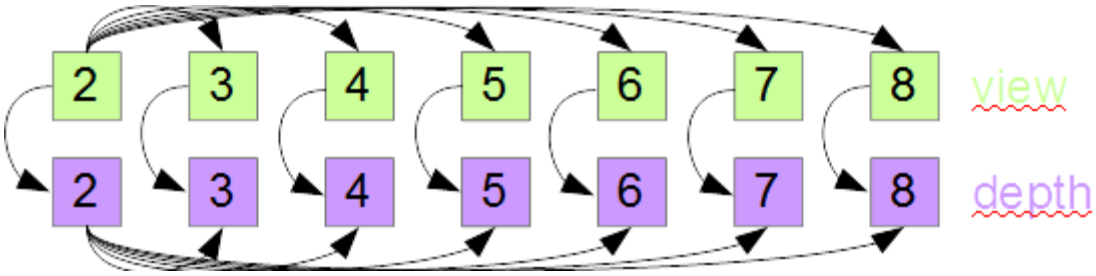


Figure 3. Inter-view prediction structure II

The bitrates and PSNR values for the structure II are given in the Table 2.

Table 2. Results for the structure II

Bitrates in kbps, PSNR in dB

Qp 25 Qd 34				
	bitrate (tx)	psnr Y (tx)	bitrate (d)	bitrate (tx+d)
View 2	1149.7096	43.8332	72.9216	1222.6312
View 3	672.7448	42.219	47.3584	720.1032
View 4	726.2432	42.4468	46.928	773.1712
View 5	692.708	42.6023	46.1136	738.8216
View 6	692.9712	42.521	42.9832	735.9544
View 7	684.1704	42.581	44.9784	729.1488
View 8	642.0864	42.79	49.308	691.3944

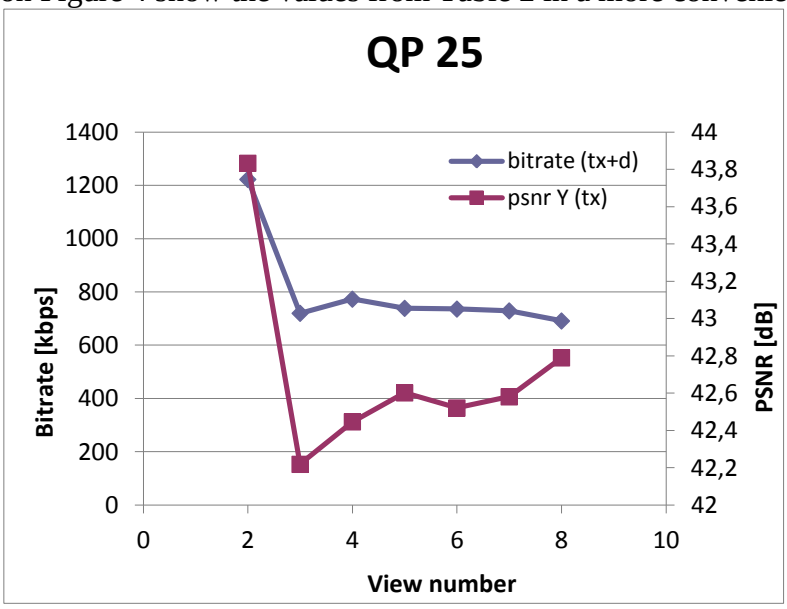
Qp 30 Qd 39				
	bitrate (tx)	psnr Y (tx)	bitrate (d)	bitrate (tx+d)
View 2	657.9408	41.282	41.2184	773.1712
View 3	356.0272	39.4793	27.8496	383.8768
View 4	411.8472	39.6311	27.8512	439.6984
View 5	400.028	39.7898	27.7592	427.7872
View 6	397.9392	39.7219	26.0064	423.9456
View 7	389.3584	39.753	26.6864	416.0448
View 8	368.8696	40.0273	29.9312	398.8008

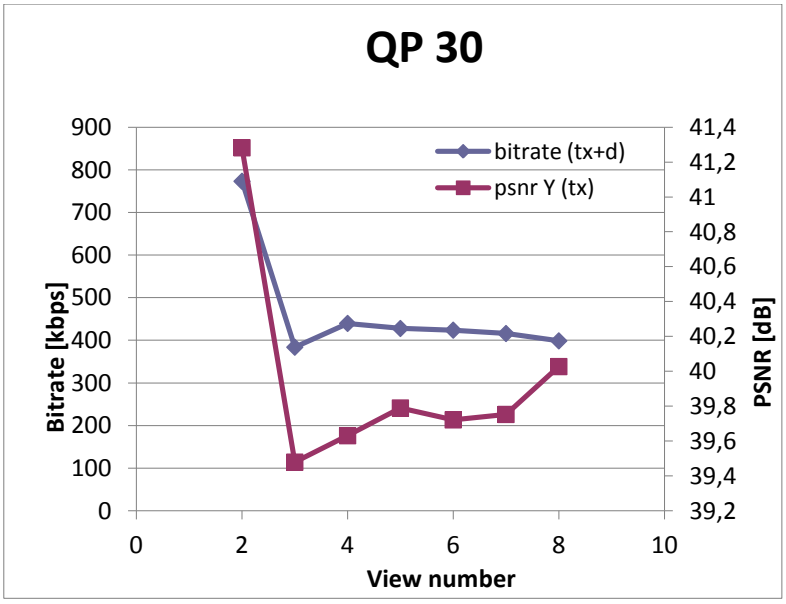
Qp 35 Qd 44				
	bitrate (tx)	psnr Y (tx)	bitrate (d)	bitrate (tx+d)
View 2	383.8656	38.4301	24.5936	408.4592
View 3	196.9456	36.6156	17.2656	214.2112
View 4	236.8736	36.667	16.9176	253.7912
View 5	237.764	36.8085	17.6128	255.3768
View 6	235.2312	36.7681	16.3984	251.6296
View 7	228.3808	36.8342	17.124	245.5048
View 8	218.5496	37.1196	18.8656	237.4152

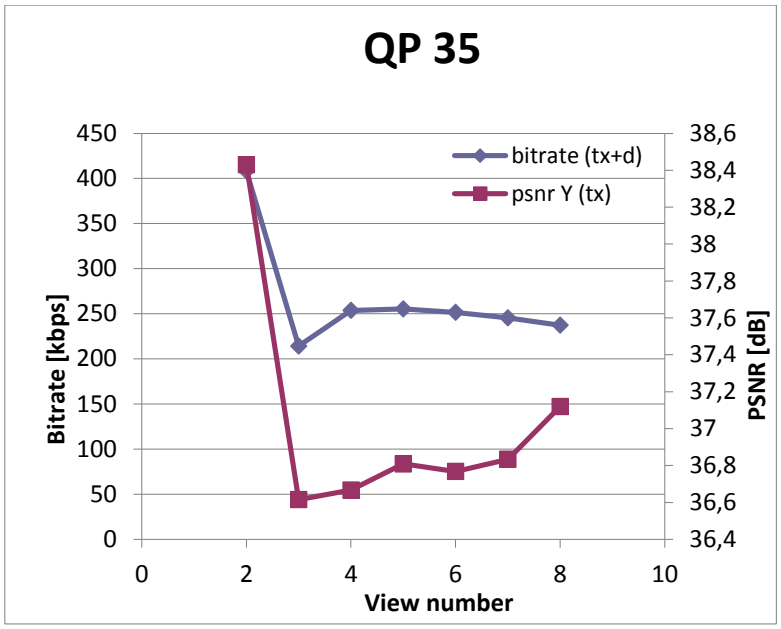
Qp 40 Qd 49				
	bitrate (tx)	psnr Y (tx)	bitrate (d)	bitrate (tx+d)
View 2	226.6632	35.4352	15.624	242.2872

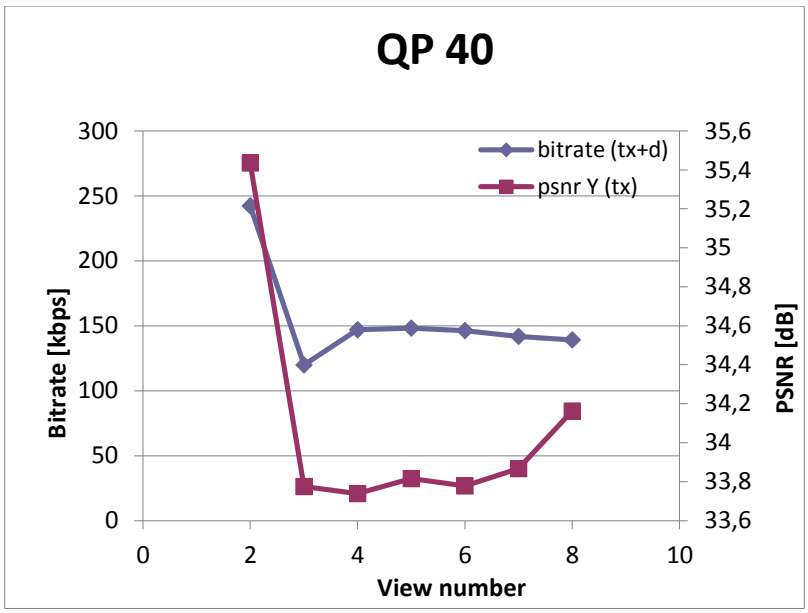
View 3	108.5984	33.7747	11.188	119.7864
View 4	135.748	33.7387	11.156	146.904
View 5	136.5608	33.8155	11.5888	148.1496
View 6	134.9096	33.7783	11.36	146.2696
View 7	130.0072	33.8668	11.816	141.8232
View 8	126.604	34.1621	12.5048	139.1088

The graphs on Figure 4 show the values from Table 2 in a more convenient way.






QP 35
bitrate (tx+d)
psnr Y (tx)
Bitrate [kbps]
PSNR [dB]
View number
450
400
350
300
250
200
150
100
50
0
38,6
38,4
38,2
38
37,8
37,6
37,4
37,2
37
36,8
36,6
36,4
0
2
4
6
8
10


QP 40
bitrate (tx+d)
psnr Y (tx)
Bitrate [kbps]
PSNR [dB]
View number
300
250
200
150
100
50
0
35,6
35,4
35,2
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34,8
34,6
34,4
34,2
34
33,8
33,6
0
2
4
6
8
10

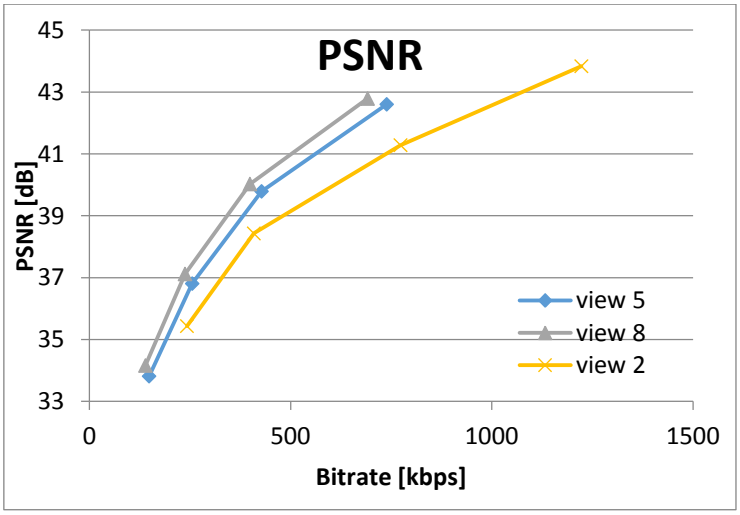

PSNR
PSNR [dB]
Bitrate [kbps]
view 5
view 8
view 2
45
43
41
39
37
35
33
0
500
1000
1500

Figure 4. The results for structure II

Structure III

Third structure of inter-view prediction is shown on Figure 5.

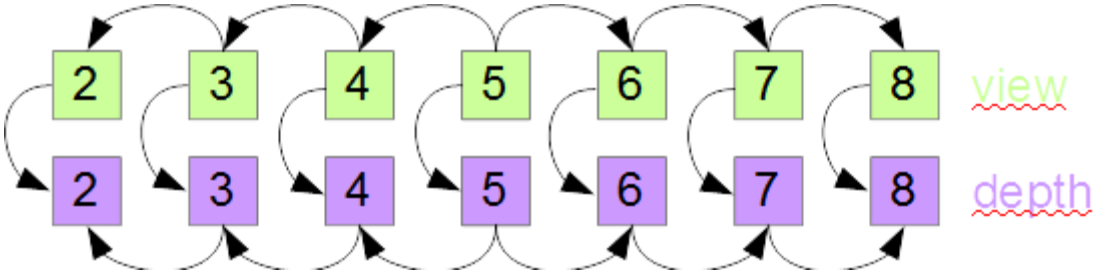


Figure 5. Inter-view prediction structure III

The bitrates and PSNR values for the structure III are given in the Table 3.

Table 3. Results for the structure III
Bitrates in kbps, PSNR in dB

Qp 25 Qd 34				
	bitrate (tx)	psnr Y (tx)	bitrate (d)	bitrate (tx+d)
View 2	705,796	42,0712	50,952	756,748
View 3	697,4472	42,1022	47,368	744,8152
View 4	614,5576	42,5498	46,5312	661,0888
View 5	1001,2552	44,3456	64,8776	1066,1328
View 6	593,96	42,6615	42,0736	636,0336
View 7	580,2792	42,6269	44,0264	624,3056
View 8	597,4152	42,8559	48,0416	645,4568

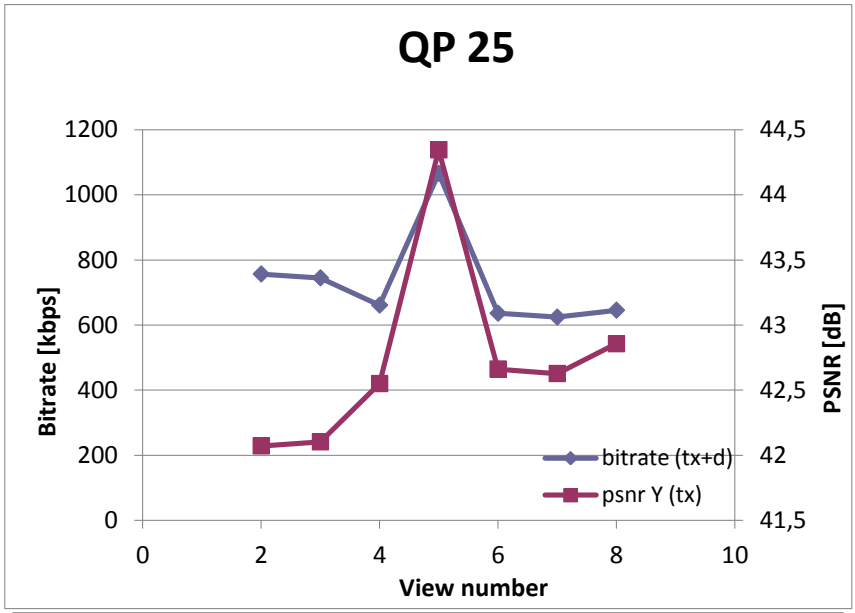
Qp 30 Qd 39				
	bitrate (tx)	psnr Y (tx)	bitrate (d)	bitrate (tx+d)
View 2	384,5432	39,214	29,4096	661,0888
View 3	380,7848	39,2601	27,8888	408,6736
View 4	326,4872	39,8367	27,5192	354,0064
View 5	569,5408	41,8002	37,9672	607,508
View 6	314,908	39,9727	25,1376	340,0456
View 7	303,3096	39,8306	25,964	329,2736
View 8	322,0384	40,1141	28,4168	350,4552

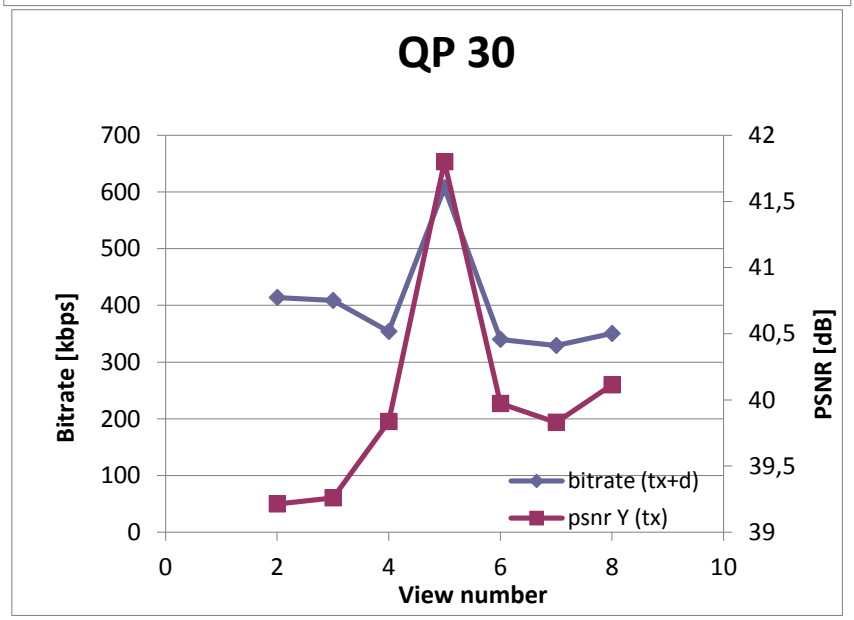
Qp 35 Qd 44				
	bitrate (tx)	psnr Y (tx)	bitrate (d)	bitrate (tx+d)
View 2	214,6264	36,238	18,2336	232,86
View 3	213,2736	36,301	17,0848	230,3584
View 4	183,4504	36,9976	16,8176	200,268
View 5	332,0096	38,9854	23,0904	355,1
View 6	173,0288	37,173	15,8464	188,8752
View 7	166,3704	37,023	16,4624	182,8328

View 8	179,6464	37,2793	17,6824	197,3288

Qp 40 Qd 49				
	bitrate (tx)	psnr Y (tx)	bitrate (d)	bitrate (tx+d)
View 2	118,0712	33,2788	12,1576	130,2288
View 3	116,5824	33,3788	11,0376	127,62
View 4	101,5032	34,1483	10,8896	112,3928
View 5	195,5912	36,0316	14,8648	210,456
View 6	95,5224	34,4039	10,6944	106,2168
View 7	91,2384	34,2634	11,0816	102,32
View 8	100,8128	34,4273	11,596	112,4088

The graphs on Figure 6 show the values from Table 3 in a more convenient way.





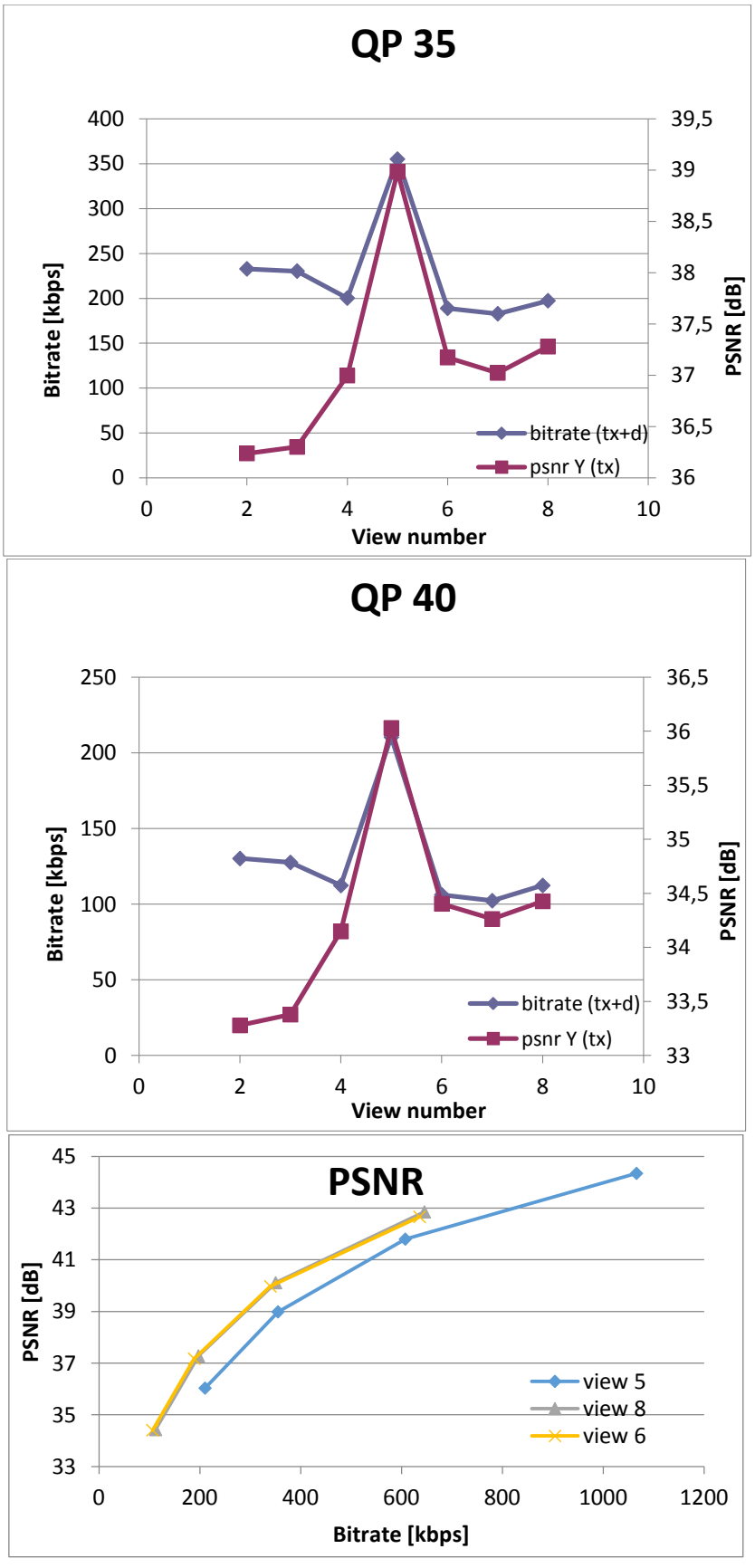


Figure 6. The results for structure III

3 Comparison of structures

The average performance of compression using those 3 structures is shown on Figure 7.

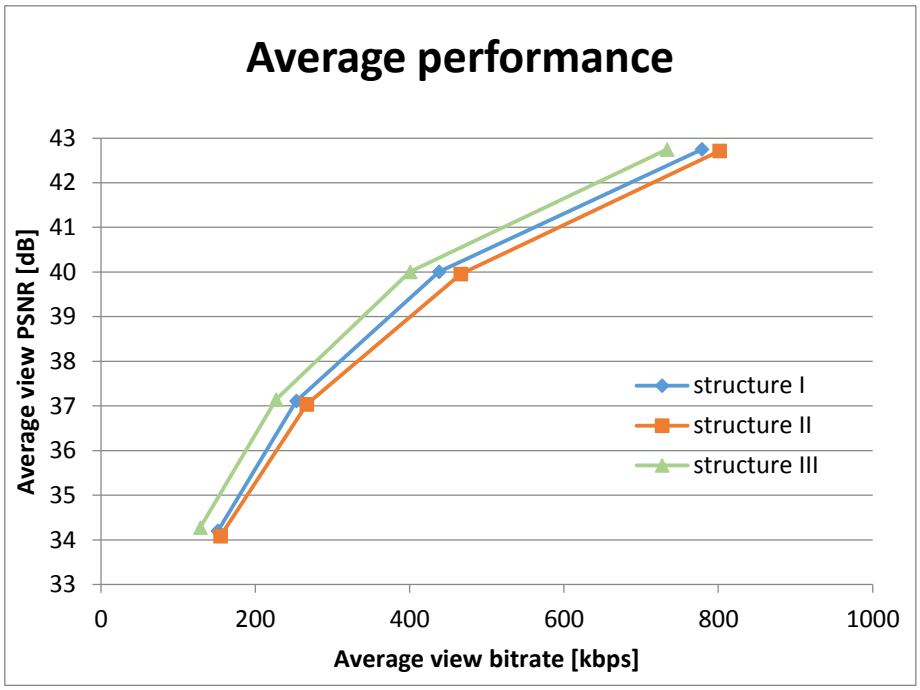


Figure 7. Average performance for 3 considered structures.

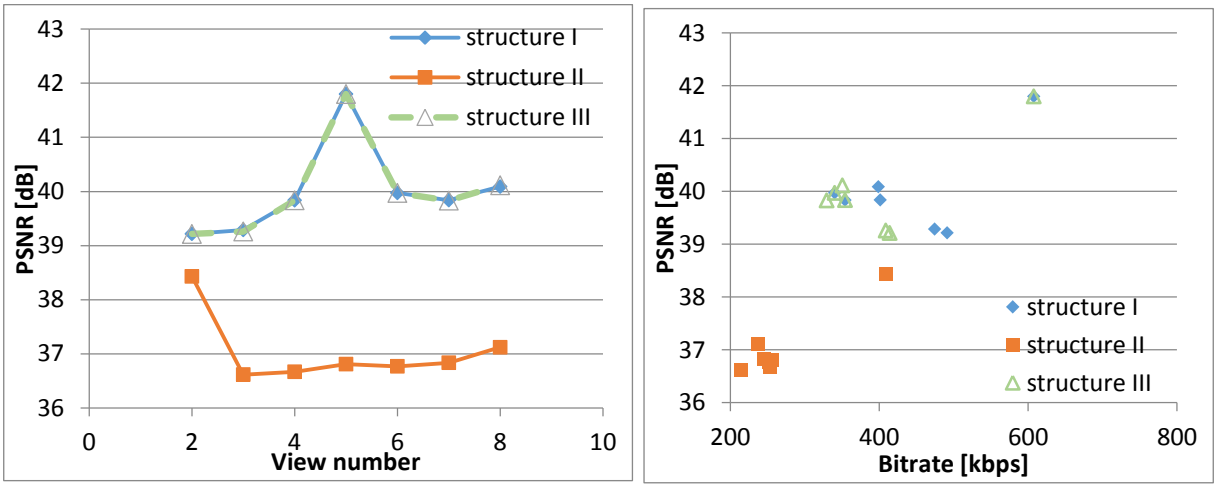


Figure 8. Comparison of performance for QP = 30.

4 Example images

In the Figures 9 and 10 there are reconstructed images (frame 70 from view 6) from the sequence compressed using QP 25 and 40.

Figure 9. Sample reconstructed frames from Poznan Blocks sequence, QP = 25.

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Figure 10. Sample reconstructed frames from Poznan Blocks sequence, QP = 40.

In the Figures 11 and 12 there are images synthesized from reconstructed data. Source data compressed using QP 25 and 40. The unmodified VSRS [2] software is used.

Figure 11. Virtual view synthesized from reconstructed data compressed with QP = 25.

Figure 12. Virtual view synthesized from reconstructed data compressed with QP = 40.

5 Acknowledgement

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References

[1] Marek Domański, Adrian Dziembowski, Agnieszka Kuehn, Maciej Kurc, Adam Łuczak, Dawid Mieloch, Jakub Siast, Olgierd Stankiewicz, Krzysztof Wegner, „Poznan Blocks – a multiview video test sequence and camera parameters for Free Viewpoint Television", ISO/IEC JTC1/SC29/WG11 MPEG2014/M32243 January 2014, San Jose, USA

[2] Krzysztof Wegner, Olgierd Stankiewicz, Masayuki Tanimoto, Marek Domanski, „Enhanced View Synthesis Reference Software (VSRS) for Free-viewpoint Television", ISO/IEC JTC1/SC29/WG11 MPEG2013/M31520 October 2013, Geneva, Switzerland