M21365
Improved depth estimation with advanced occlusion handling

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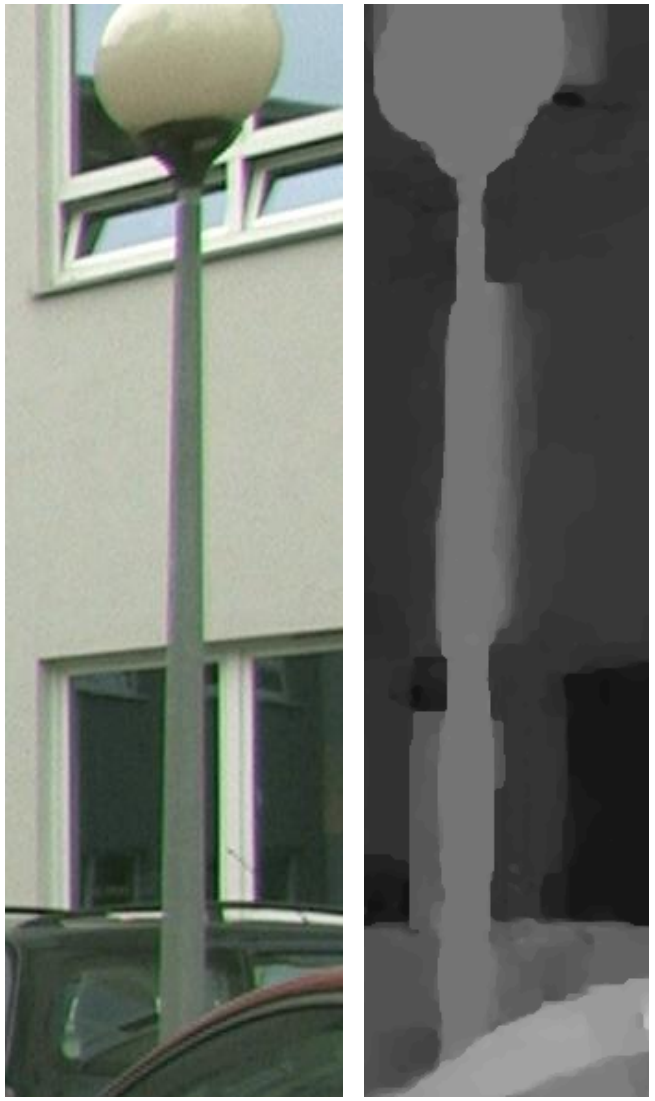
Problem

- One of the main problem with depth estimation for Poznan sequence are **large disparity gaps** in the scene which **cause occlusion** in neighboring views.



Current DERS

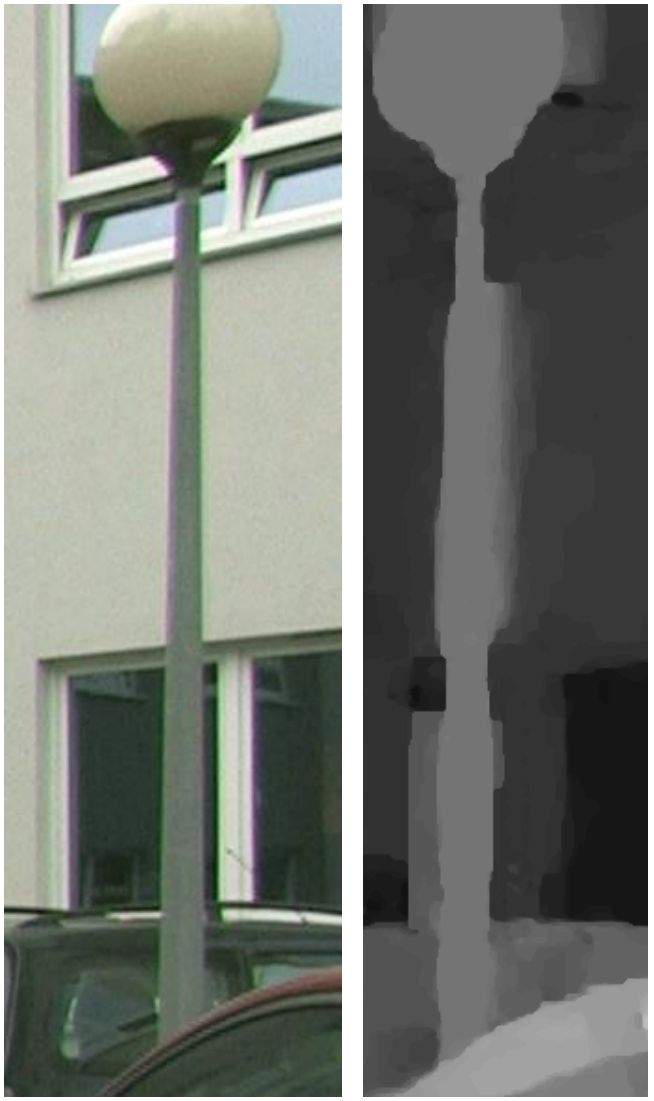
- Current version of DERS consists basically of two steps:
  - matching cost computation
    - Firstly for each pixel in the center view, matching cost of given pixel to all of the pixels in the left- and right views along the epipolar line is calculated.
  - graph-cut optimization.
    - Then the most likely disparity value for every pixel is obtained by minimization of a cost energy function by graph-cut algorithm. The energy function consists of a similarity term (the matching cost), and a smoothing term.

Occlusion handling

- **In current version** of DERS, the similarity term (matching cost) is calculated to each of the reference views, and then **the smallest cost is simply selected**.
- In case of sequences with low texture and high disparity range, like i.e. Poznan sequences, this strategy may **case errors** in depth maps.

Errors

- Those errors mainly occur near spatial edges of objects in the foreground.



New occlusion handling

- We propose an new technique to **iteratively estimate occlusions** in reference views along with depth estimation, and use of estimated occlusion map for similarity term calculations.
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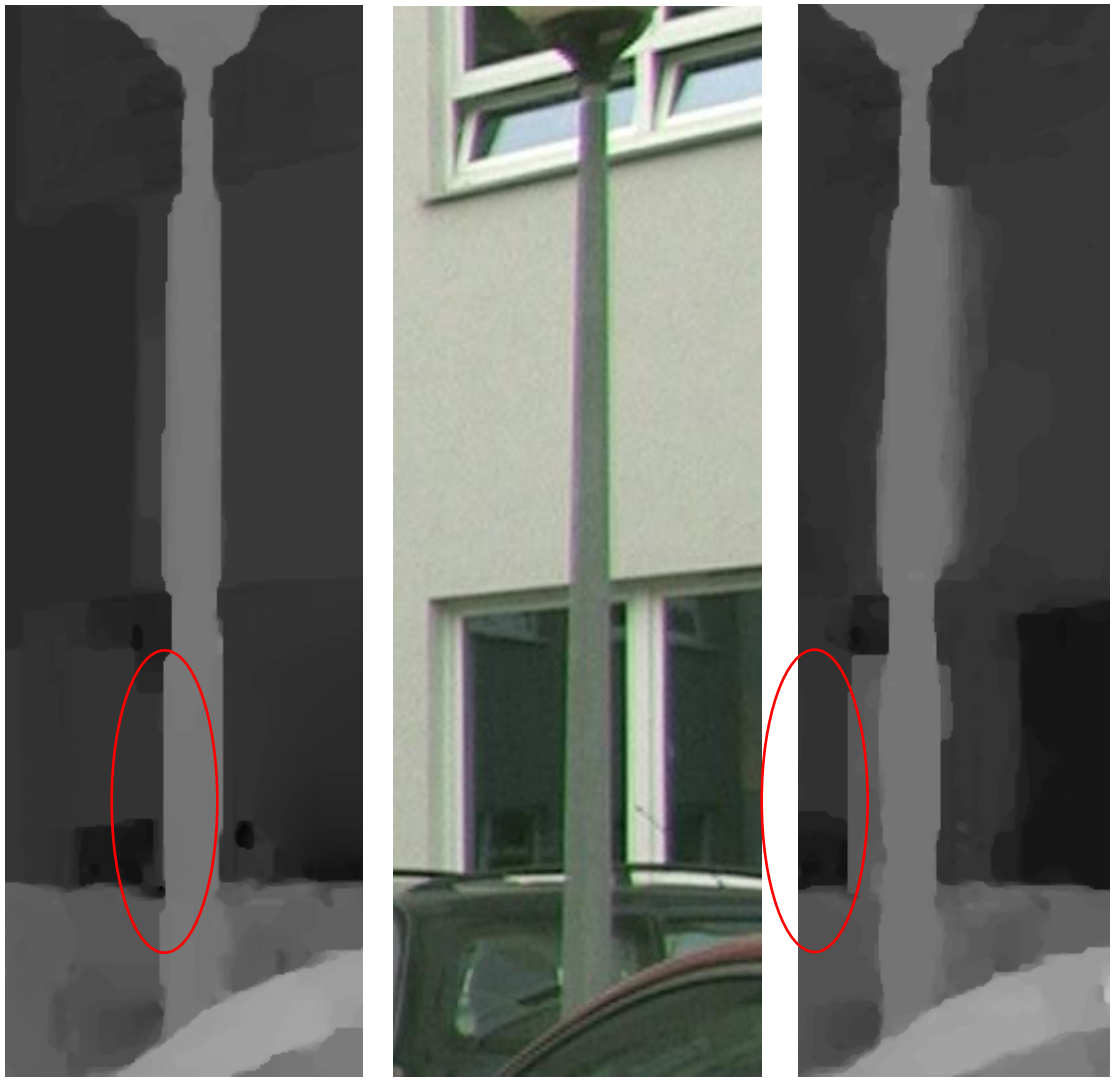
New occlusion handling

- In our proposal the similarity term is calculated based on matching between the center and left views, and the center and right views.
- And then the non-occluded one is selected. (current DERS use min-selection strategy)

New occlusion handling

- To estimate occlusion in each iteration we projected (synthesized) estimated depth map onto neighbor views
- And then test each pixels new disparity candidate against it to indicate whether it is occluded or not.

Results

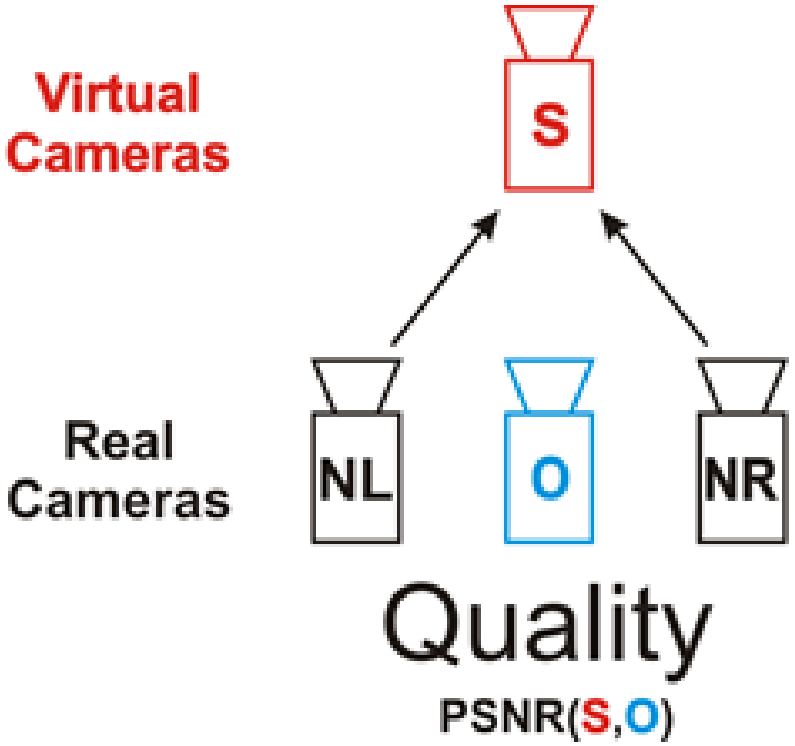


DERS - OCC

DERS

Objective evaluation

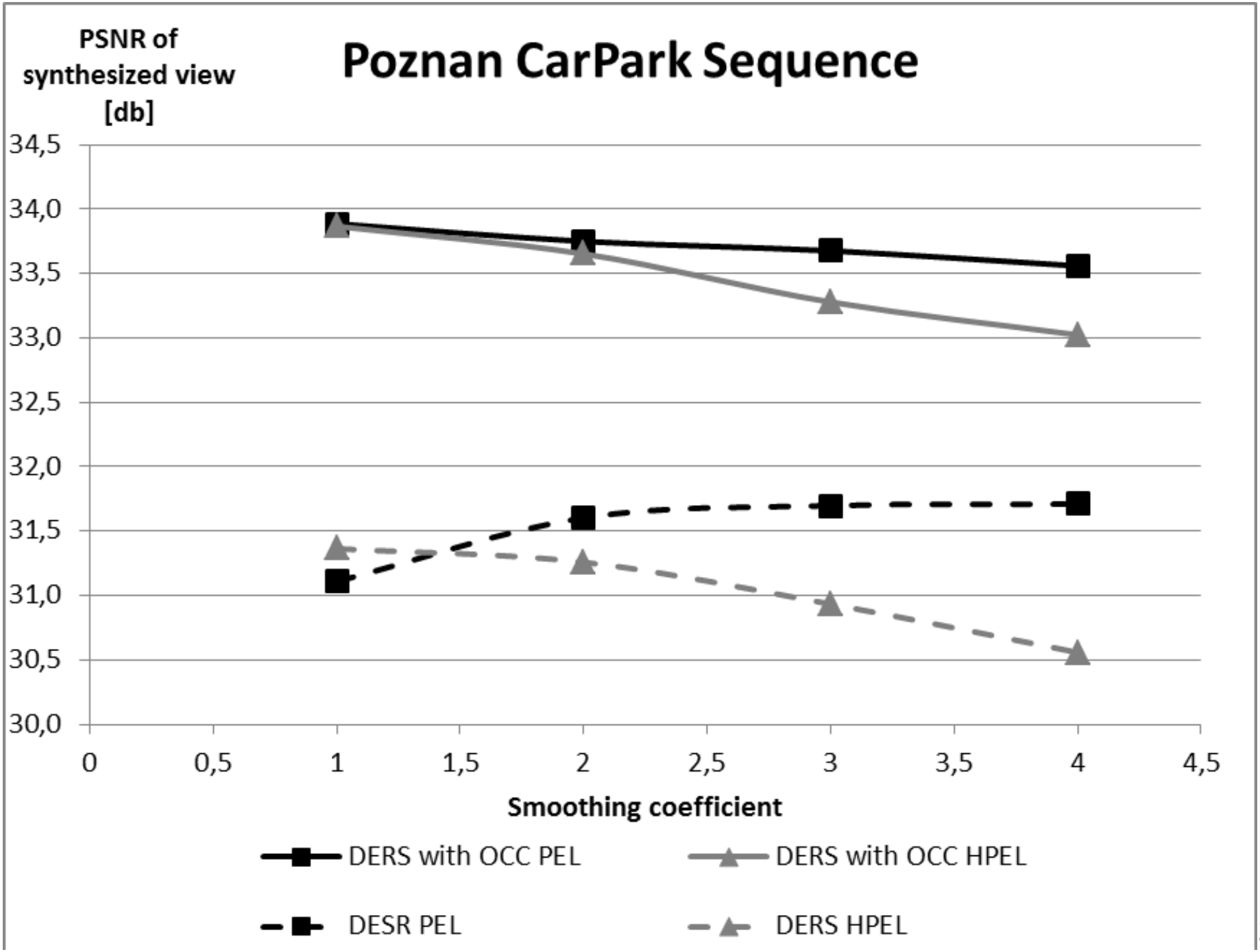
- We have compared our proposal (OCC) against current (original and not modified) version of DERS

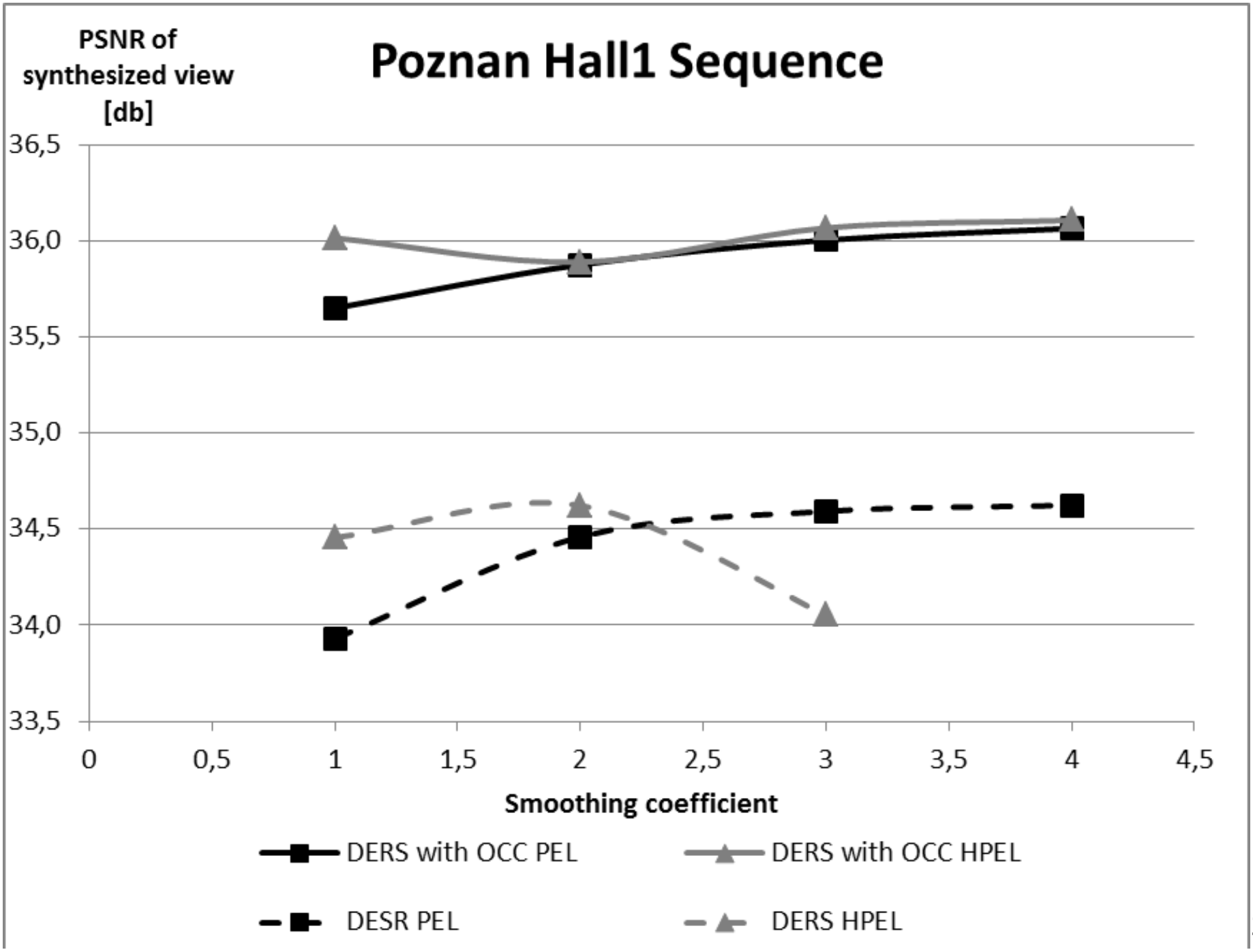


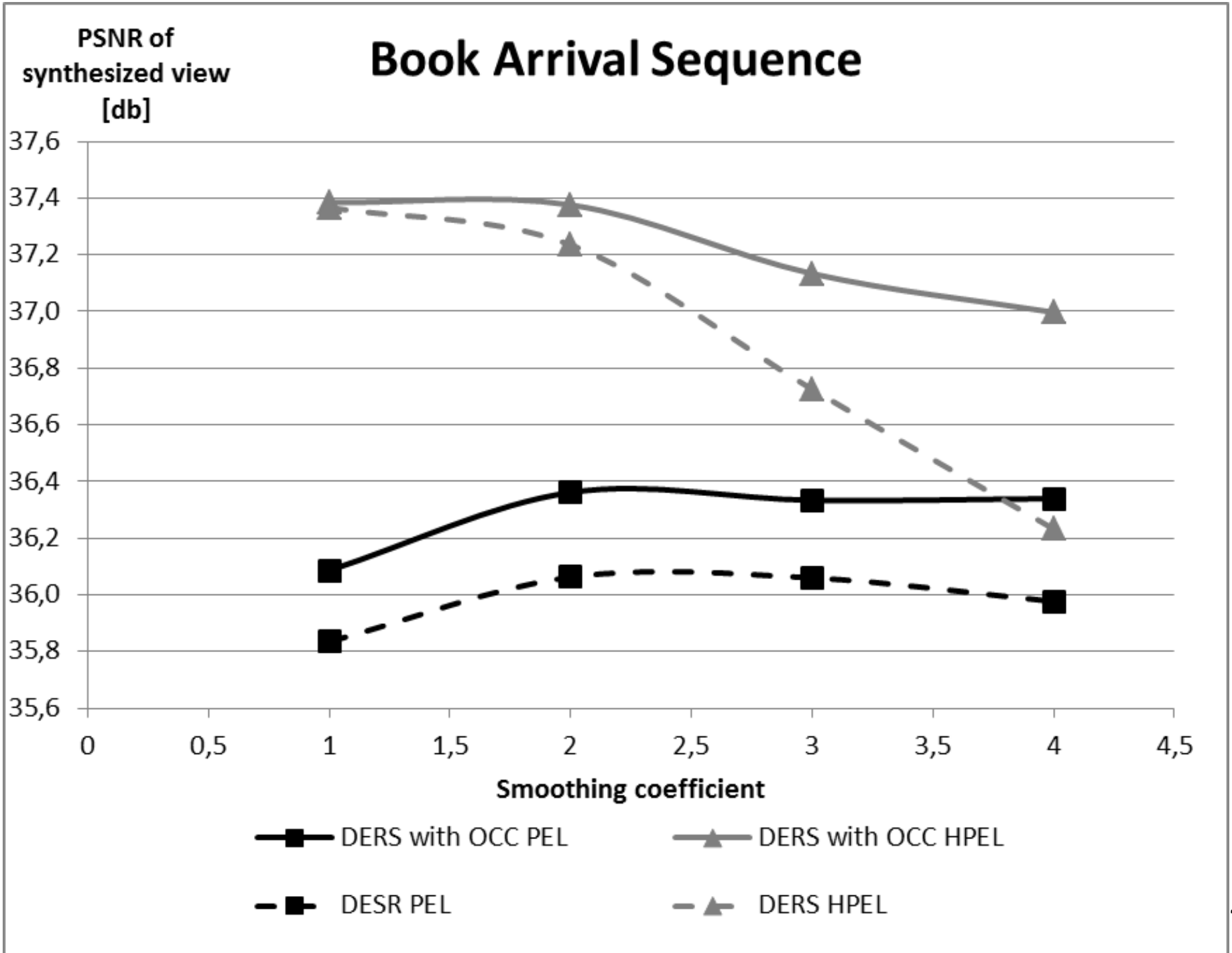
Objective evaluation

- View configuration for synthesis-based objective quality assessment.

Data set	Original Pair	Synthesized View
Poznan_Hall1	3-1	2
Poznan_Carpark	5-3	4
Book Arrival	9-7	8


Poznan CarPark Sequence
PSNR of synthesized view [db]
34,5
34,0
33,5
33,0
32,5
32,0
31,5
31,0
30,5
30,0
0
0,5
1
1,5
2
2,5
3
3,5
4
4,5
Smoothing coefficient
DERS with OCC PEL
DERS with OCC HPEL
DESR PEL
DERS HPEL


Poznan Hall1 Sequence
PSNR of synthesized view [db]
36,5
36,0
35,5
35,0
34,5
34,0
33,5
0
0,5
1
1,5
2
2,5
3
3,5
4
4,5
Smoothing coefficient
DERS with OCC PEL
DERS with OCC HPEL
DESR PEL
DERS HPEL


Book Arrival Sequence
PSNR of synthesized view [db]
37,6
37,4
37,2
37,0
36,8
36,6
36,4
36,2
36,0
35,8
35,6
0
0,5
1
1,5
2
2,5
3
3,5
4
4,5
Smoothing coefficient
DERS with OCC PEL
DERS with OCC HPEL
DESR PEL
DERS HPEL

Depth map quality

Quality of **automatically** estimated depth map have been **improved**

Conclussions

- New technique for **automatic** depth estimation can be used in various DERS configuration.
- New technique improves quality of depth maps up to 2,5 dB (in terms of PSNR of synthesized view).

- **We recommend to include our technique into DERS as a new mode.**