



# Fast View Synthesis through Depth Simplification

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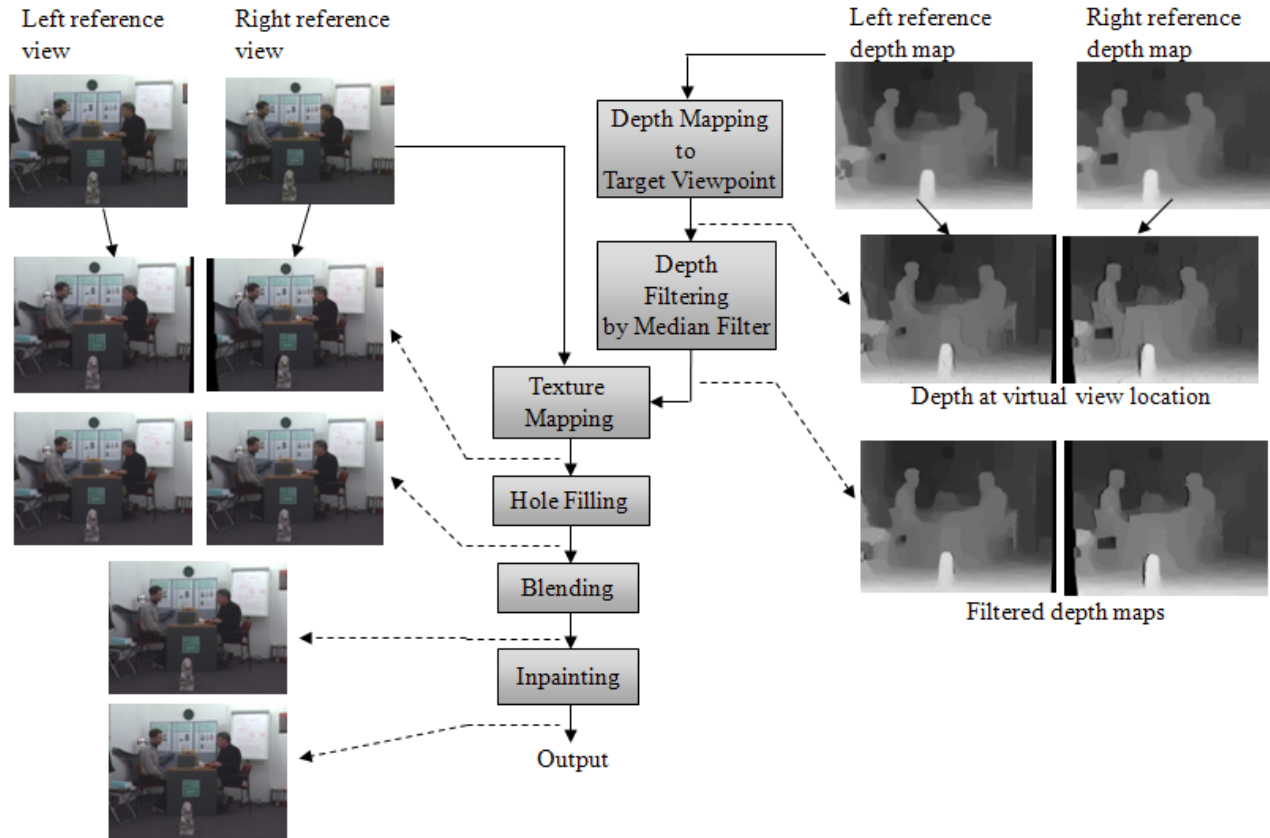
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m34298, July 2014, Sapporo

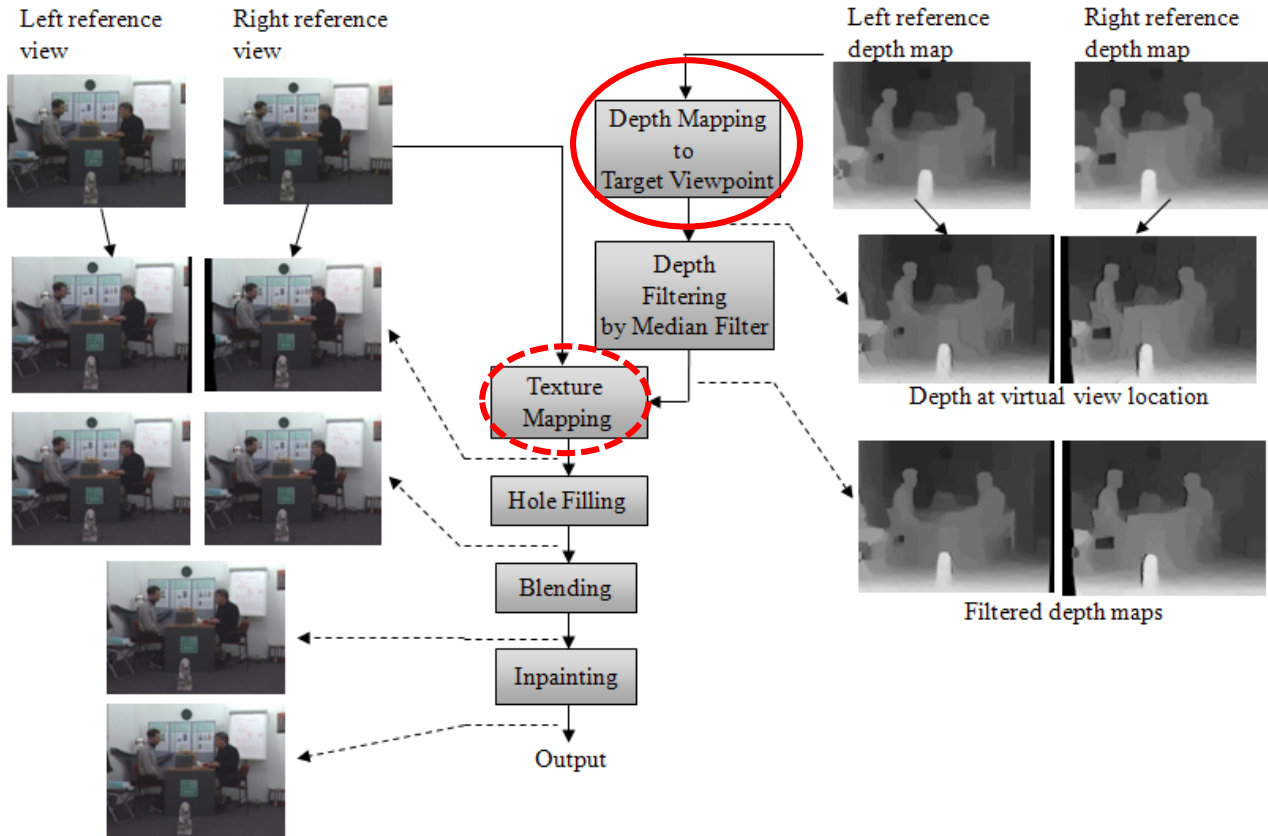
# View synthesis

- Most of view synthesis algorithms are composed of
  - Point transformation (mapping to target viewpoint)
  - Hole filling
  - View blending
  - Inpainting



# View synthesis

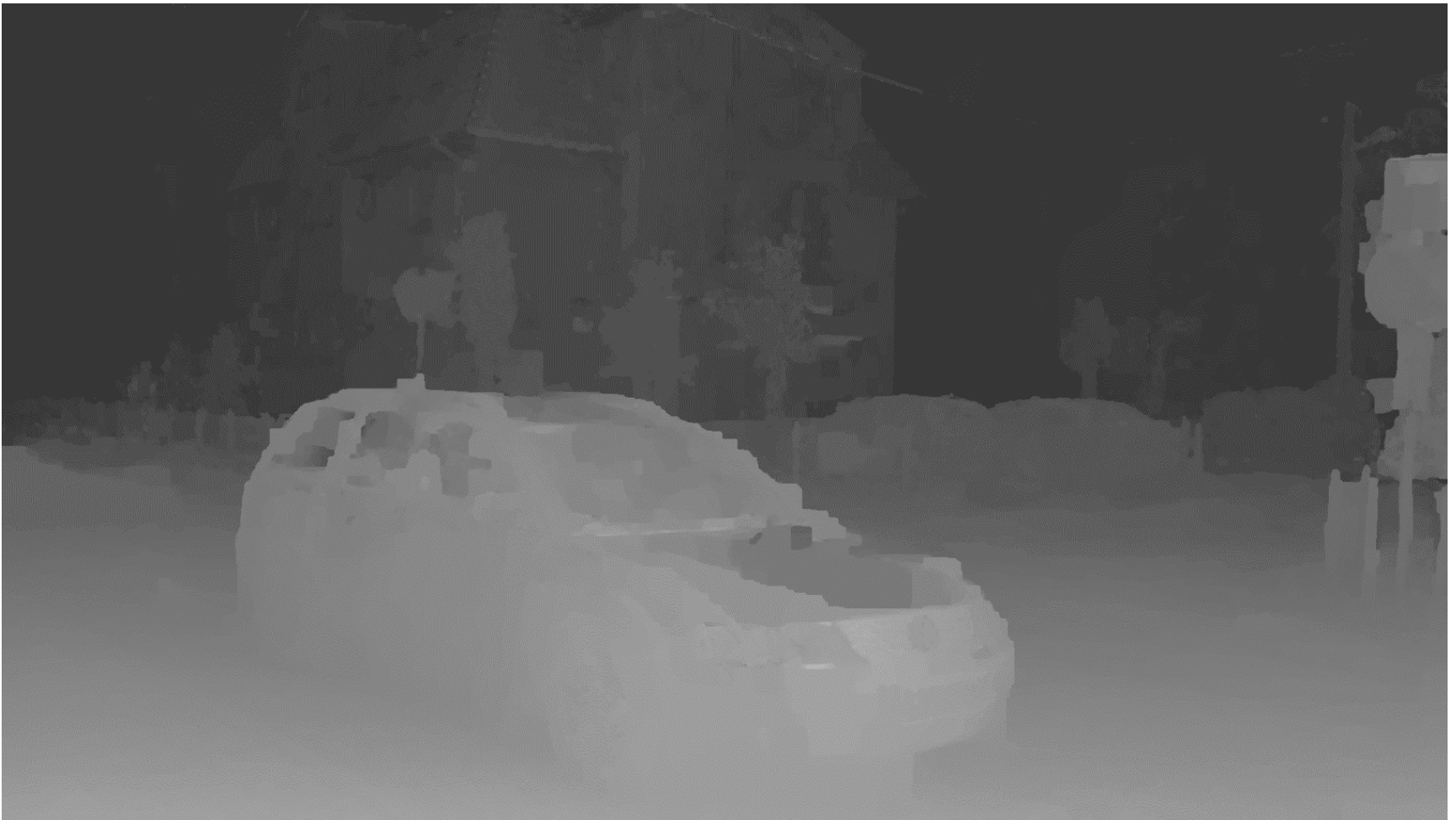
- Most of view synthesis algorithms are composed of
  - **Point transformation (mapping to target viewpoint)**
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# Depth map characteristics

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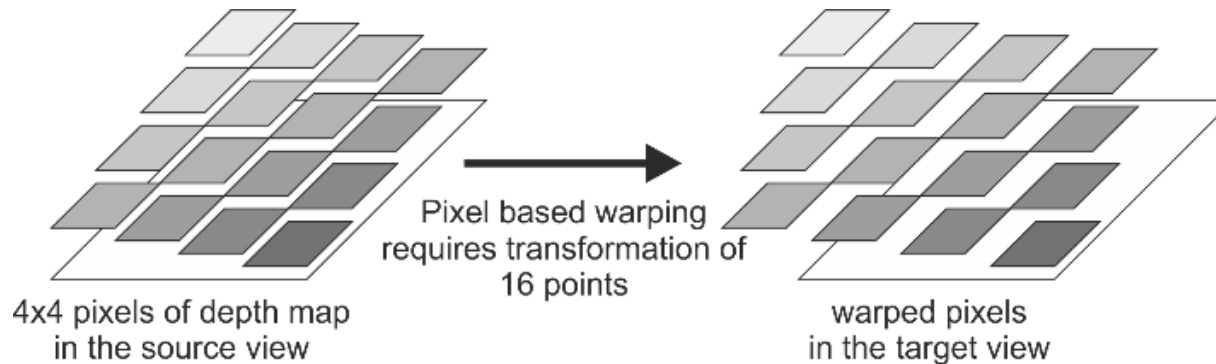
- Smooth surfaces
- Divided by sharp spatial edges





# Point warping to target viewpoint

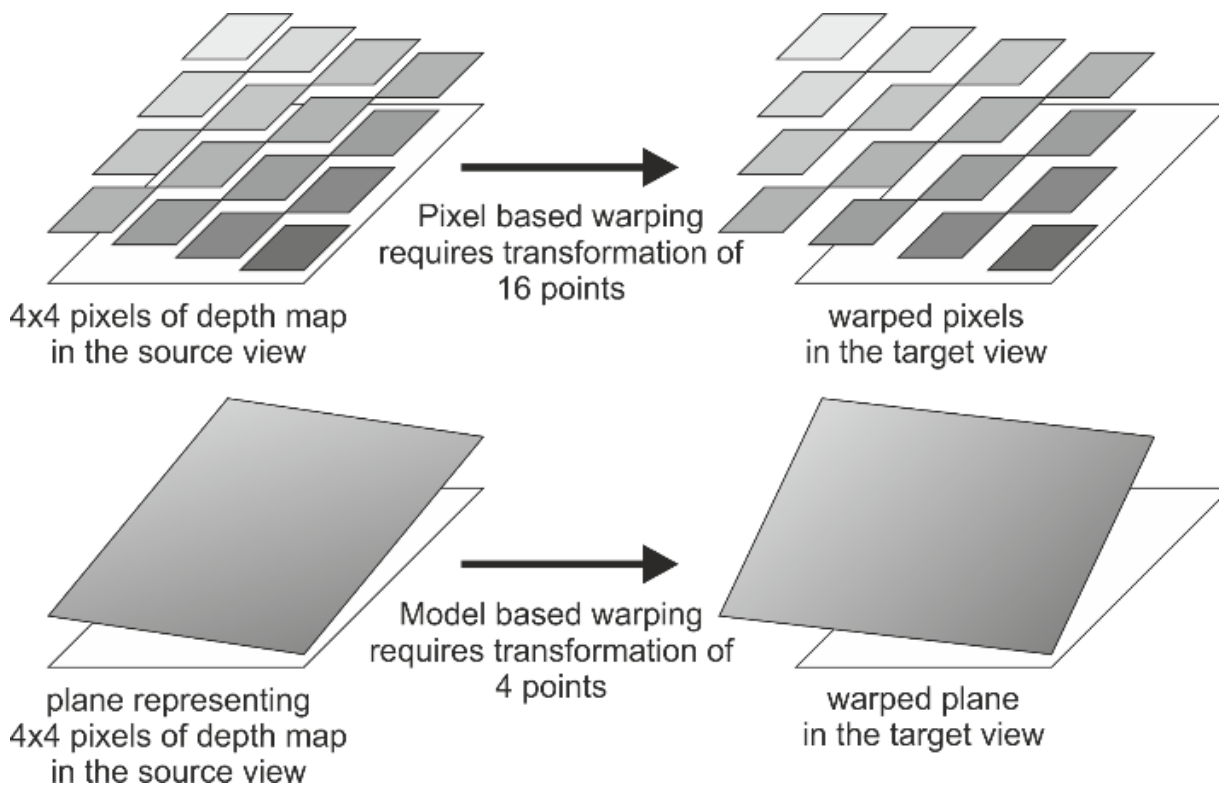
- Commonly done pixel-by-pixel
  - For  $N \times N$  block  $N^2$  operations are required





# Point warping to target viewpoint

- Commonly done pixel-by-pixel
  - For  $N \times N$  block  $N^2$  operations are required
- Approximate depth maps blocks by flat plains
  - Only 4 corners required to be transformed





# View synthesis acceleration

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- For  $N \times N$  block only 4 transformation instead  $N^2$
- Results in speed-up of image warping (mapping)

$$\textit{acceleration} = \frac{N^2}{4}$$

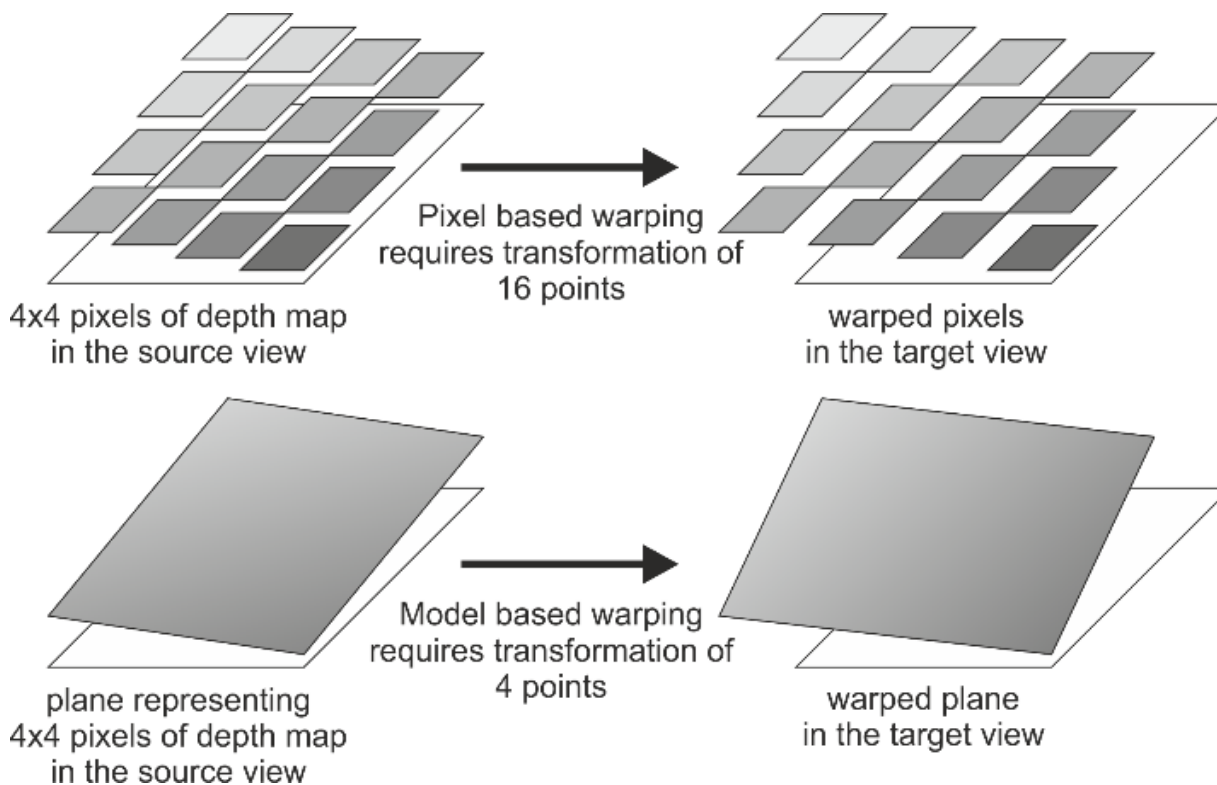
# Cracks and holes

- Pixel by pixel mapping

- Causes holes to appear after warping

- Plane base mapping

- No holes appear because plains are continuously smooth



# Depth simplification

- Depth maps are divided by spatial edges
- Depth modeling caused quality loses (errors)
  
- Solution - Adaptive partitioning
  - provides maximum transformation/view synthesis acceleration while maintained high quality view synthesis



Original depth block



Segmented depth block



# Adaptive partitioning

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- Partitioning process is controlled by Lagrangian optimization:

$$fitness = \lambda \cdot error + acceleration$$

- Similar to RD-optimization
- *error* is a depth maps approximation error
- *acceleration* is a transformation operation reduction caused by plane approximation
- $\lambda$  is a coefficient which controls preference between acceleration and quality of the view synthesis

- Plane model

$$d'(x, y) = A \cdot x + B \cdot y + C$$

- $A$ ,  $B$  and  $C$  are plane model parameters
- Plane approximation caused error in depth map

$$error = \sum_{x=0}^{N-1} \sum_{y=0}^{N-1} (d'(x, y) - d(x, y))^2$$

- Block B is partitioned onto  $k$  sub-blocks  $B_i$

- Block B error

$$error = \sum_i^k error_i$$

- Block B acceleration

$$acceleration = \frac{N^2}{\sum_{i \in B} 4}$$



Original  
depth block  
 $N^2$   
transformation

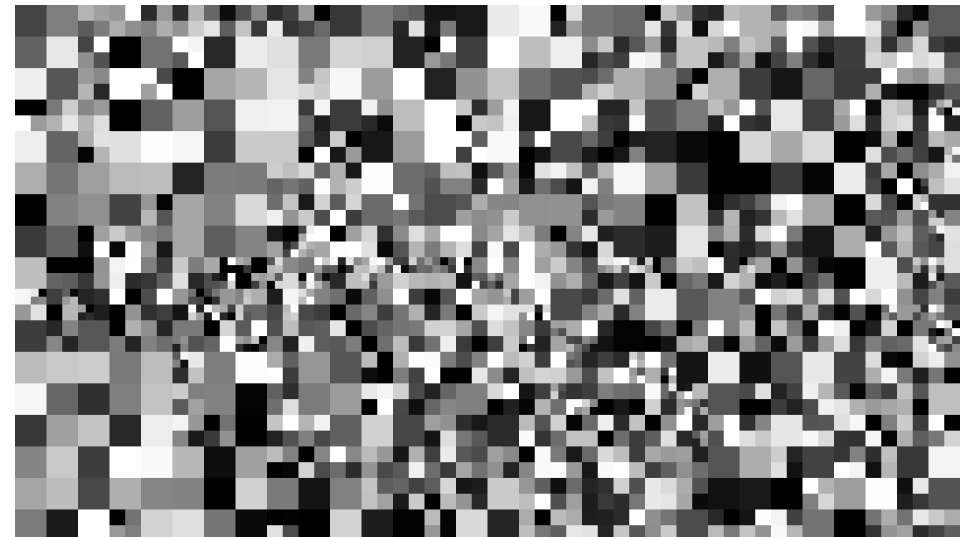


Segmented  
depth block  
16 sub-blocks  
only 64 corners

- Small blocks at the object borders
- Large block at smooth areas
- Depth simplification controlled by  $\lambda$

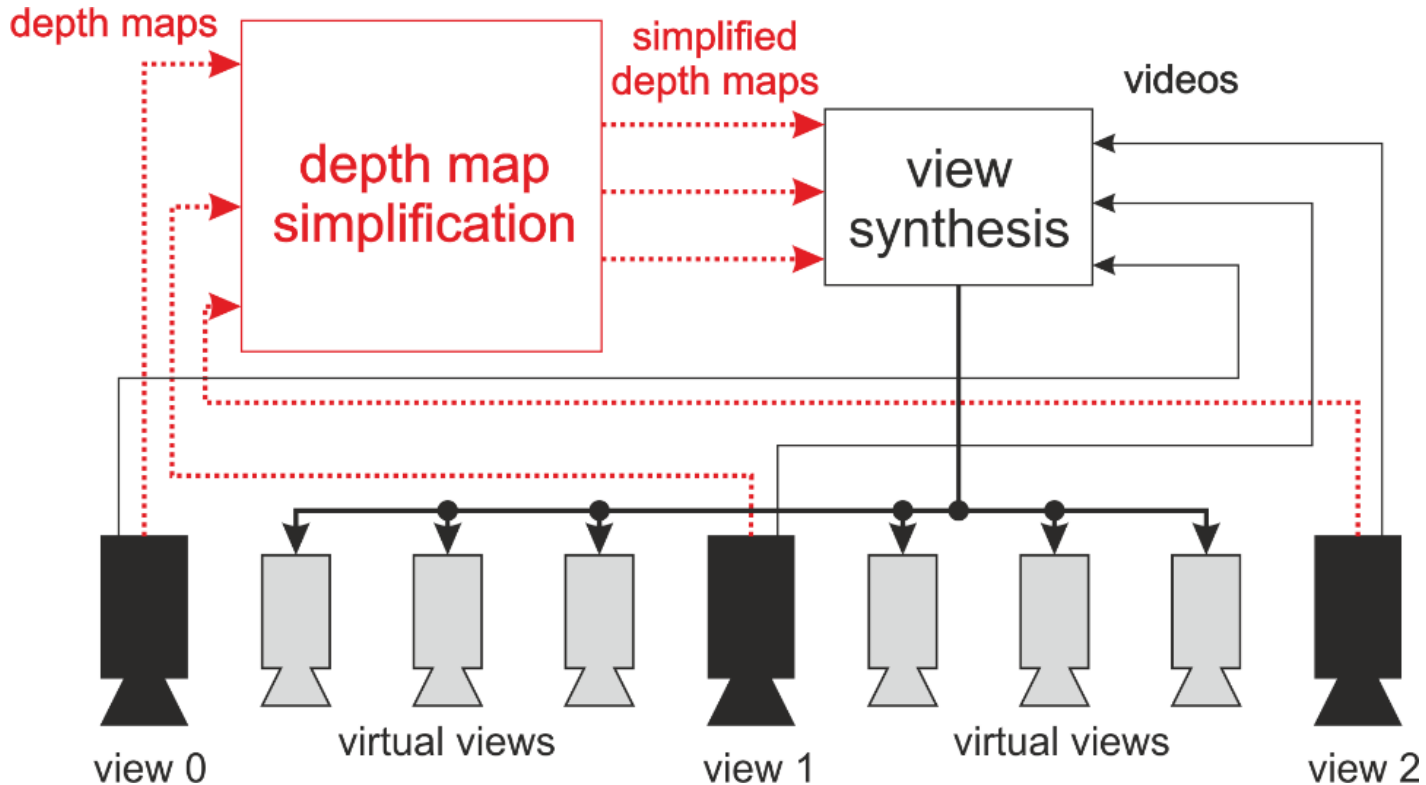


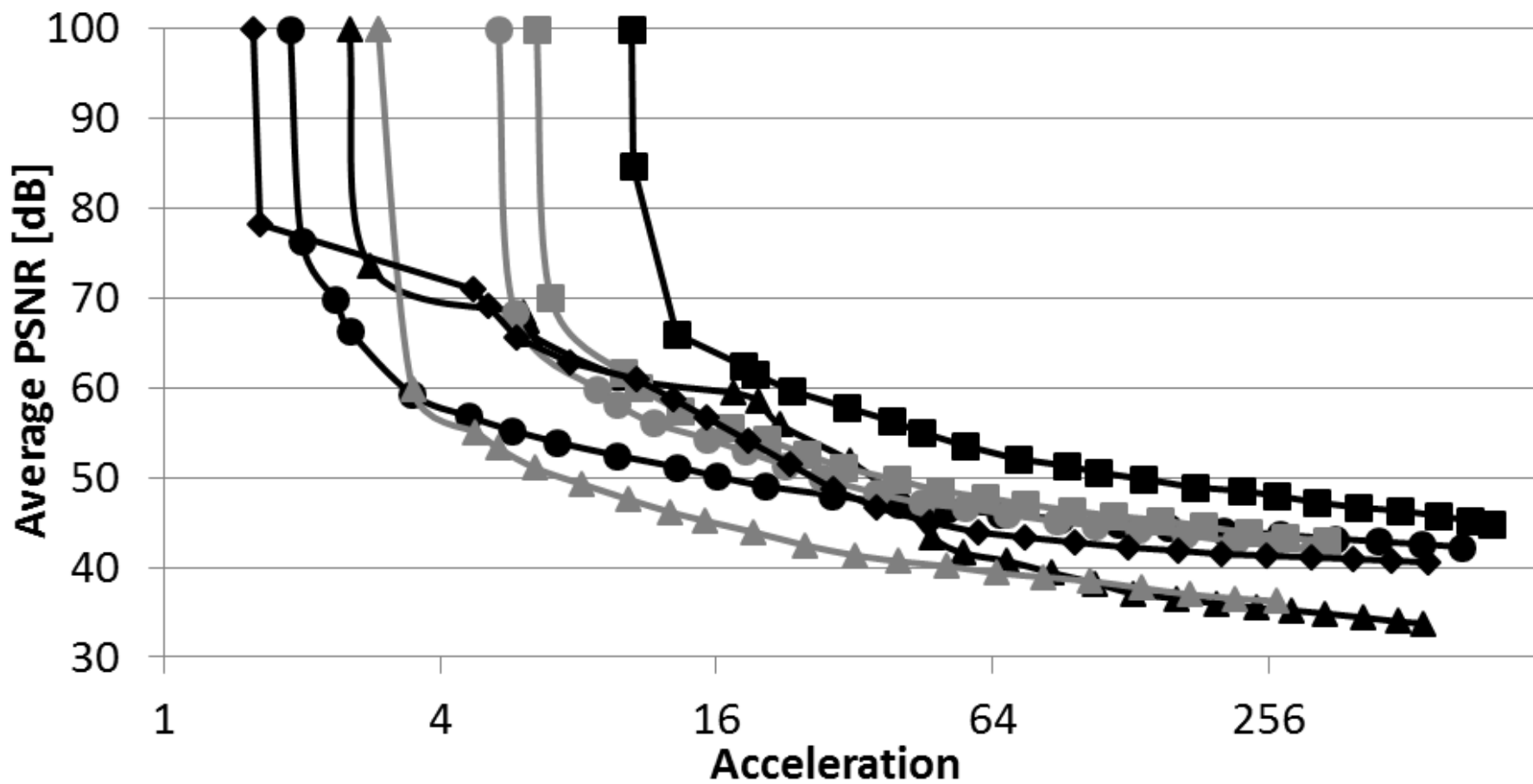
Original depth map



Resultant partitioning

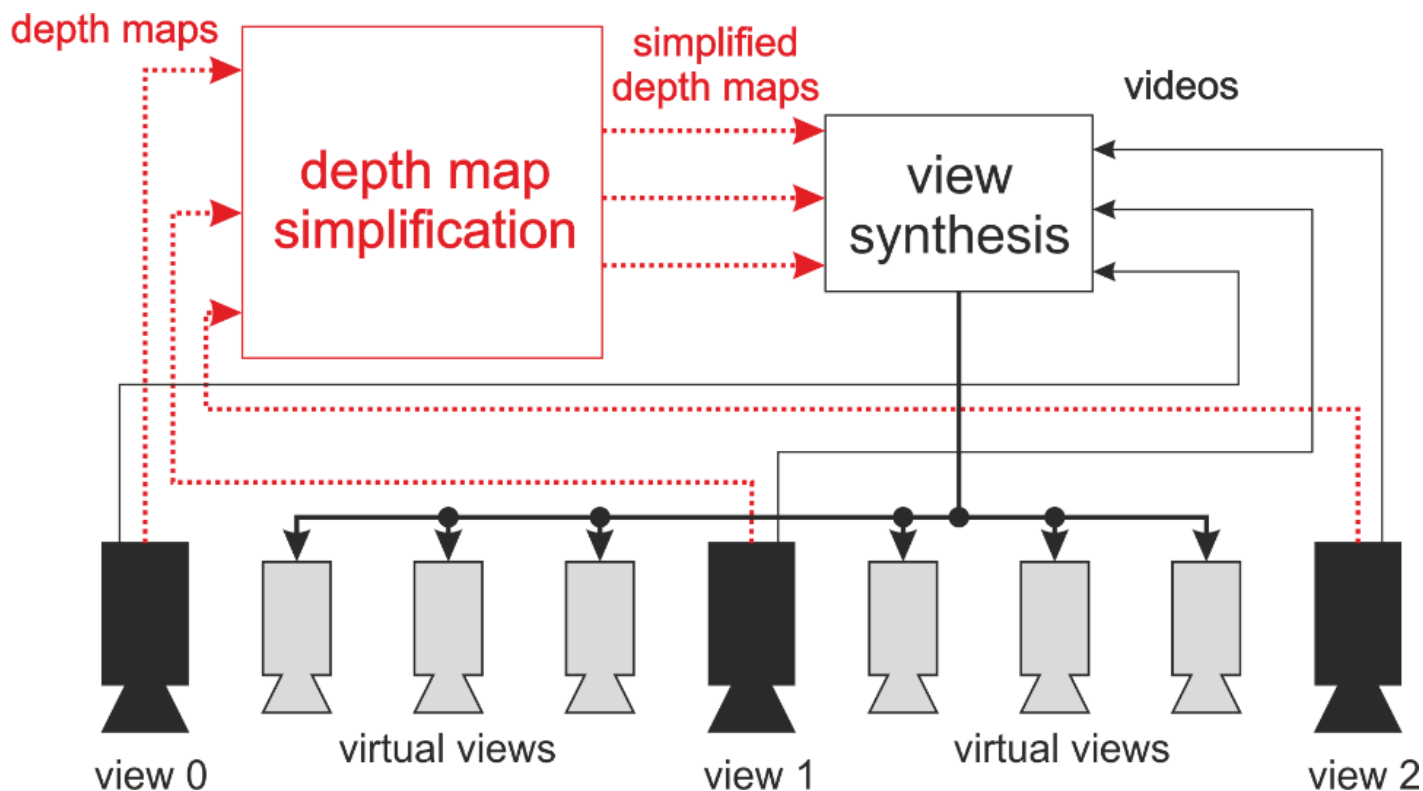
- Seven 3D test sequences used





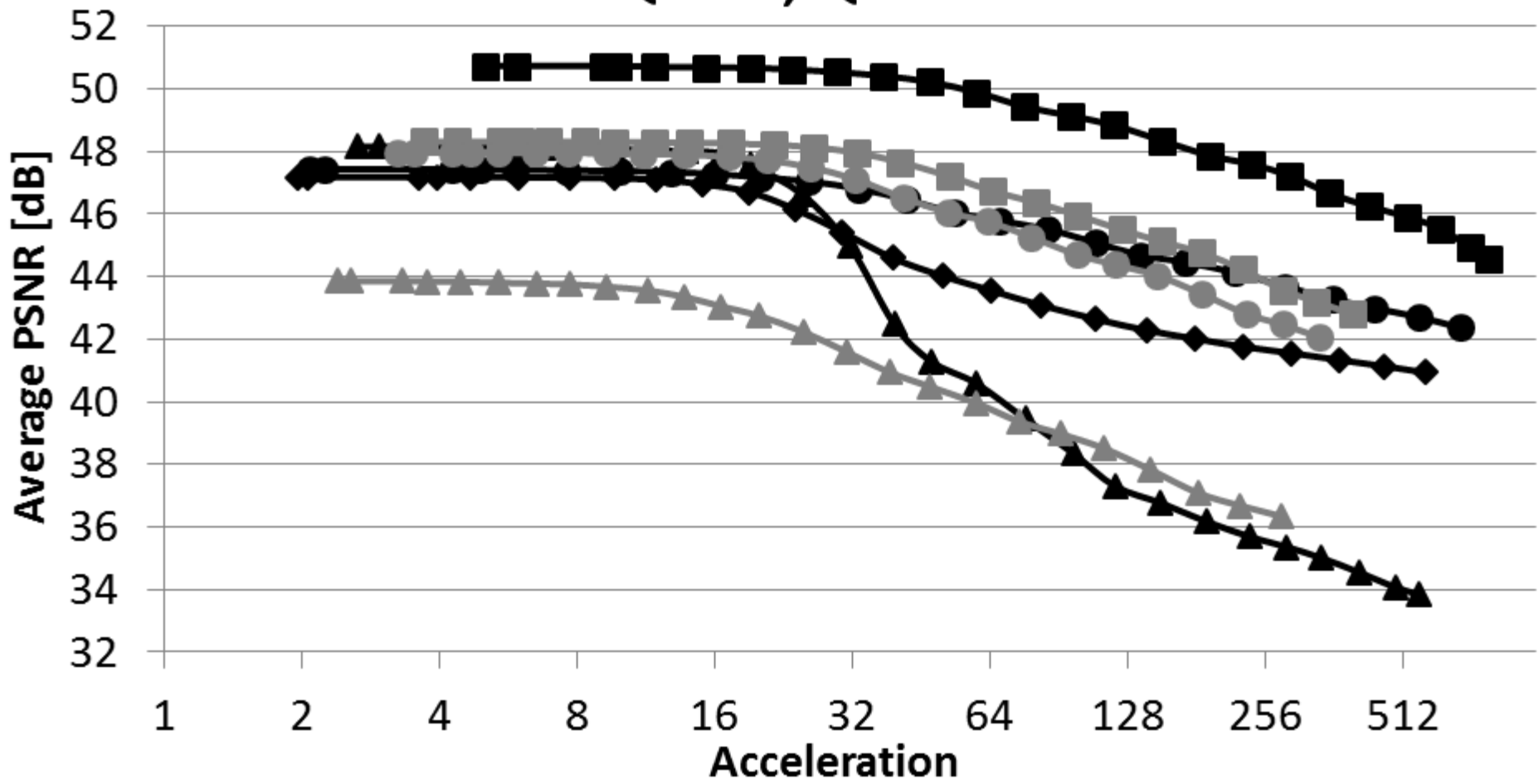
- Poznan Street
- ▲ Dancer
- Kendo
- Balloons
- ▲ Newspaper CC
- Poznan Hall2
- ◆ GT Fly

- Data compressed by 3D-HEVC
- Following CTC - (25,34), (30,39), (35,42), (40,45)
- Decompressed depth have been simplified



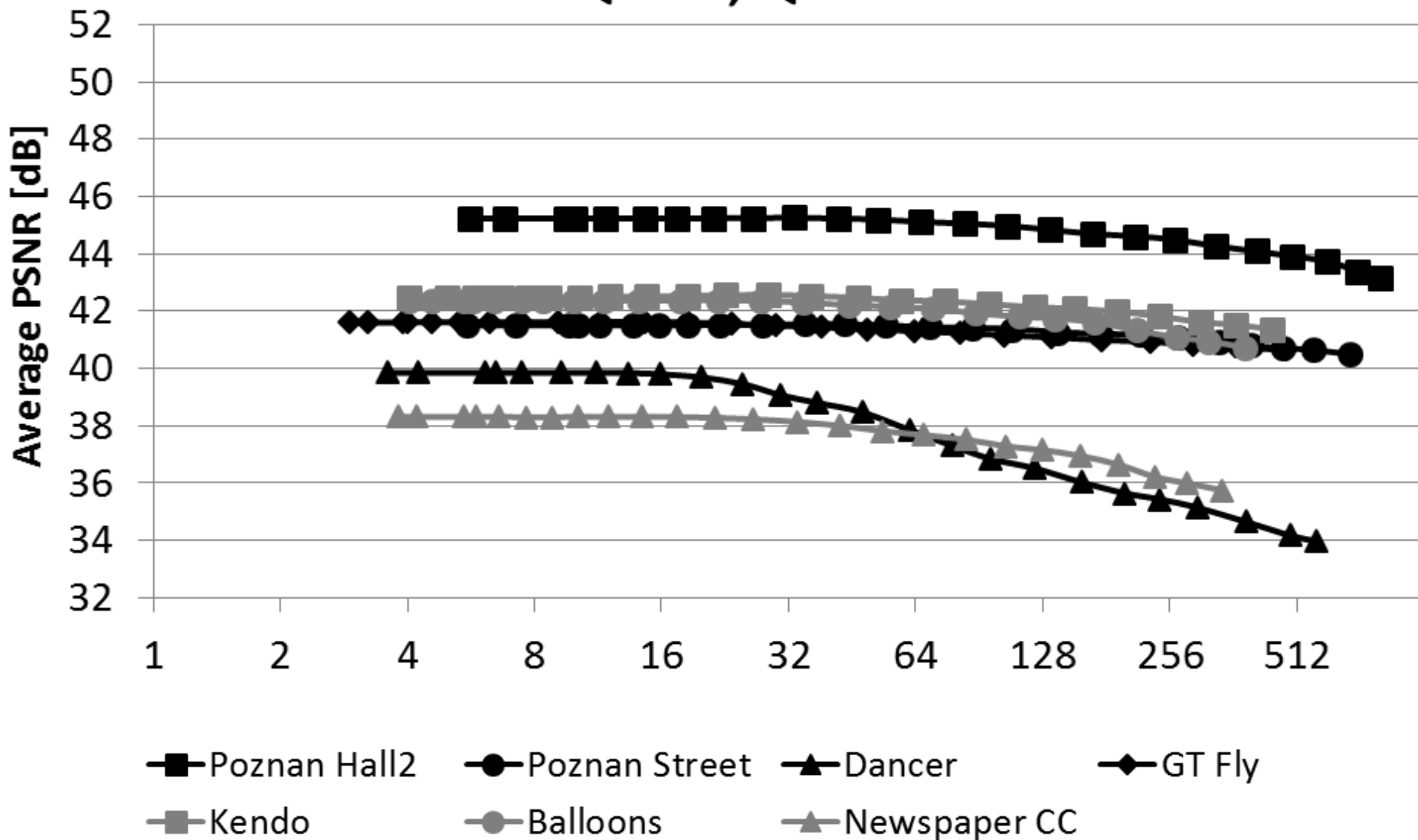


QP=25, QD=34



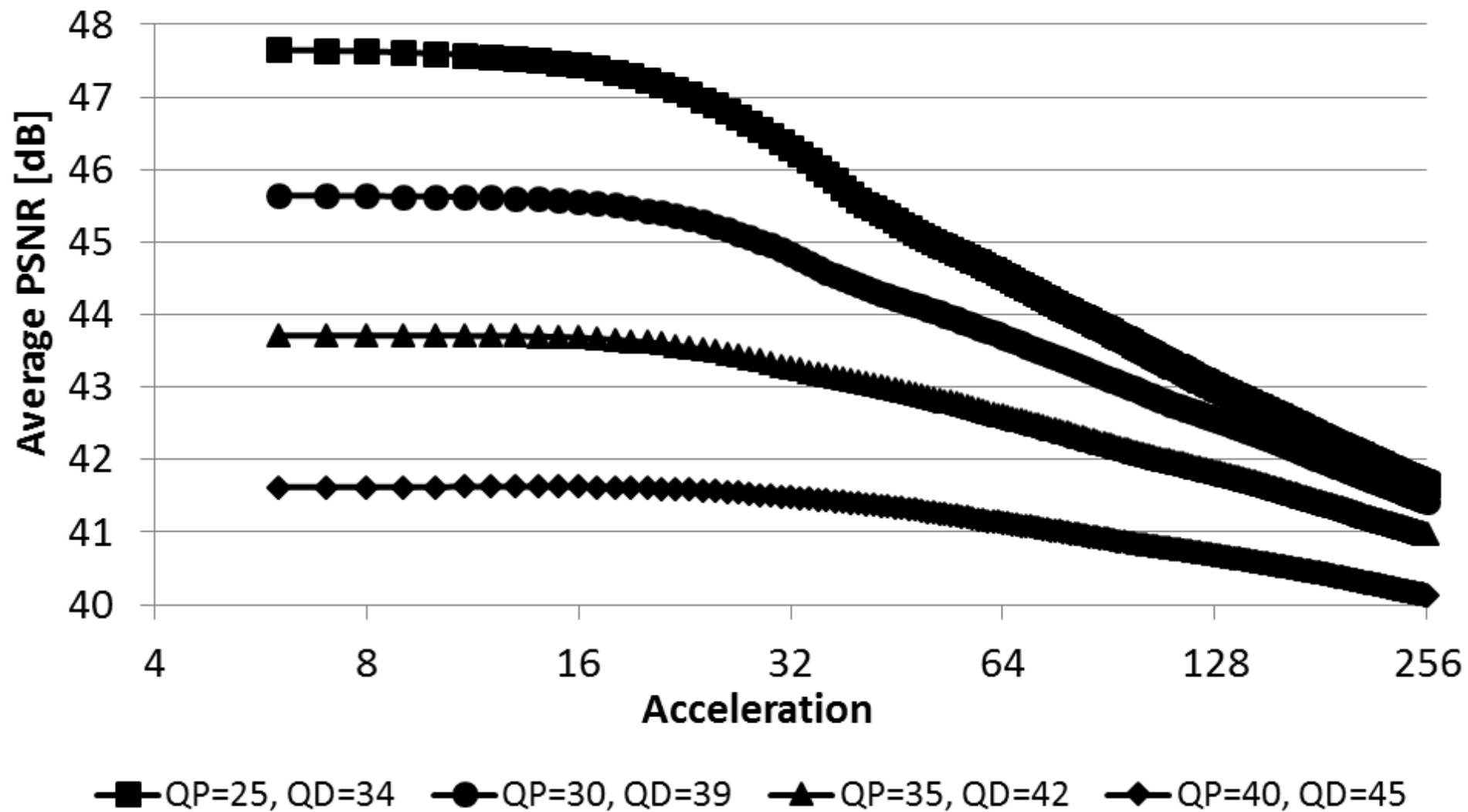
- Poznan Hall2
- Poznan Street
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- Balloons
- ▲ Newspaper CC

QP=40, QD=45





# Average over all sequence



- A novel approach to depth map simplification and view synthesis acceleration has been presented
- Provides **×16 to ×256** acceleration with negligible quality loss
- Level of acceleration and quality degradation can be **smoothly controlled**



# Questions?

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