# An Occlusion Probability Model for Improving the Rendering Quality of Views

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## Problem

Occlusion quantification for image-based rendering (IBR)

- 3D spatial structure of some features may be missing
- to capture some incorrect samples caused by occlusion discontinuities.

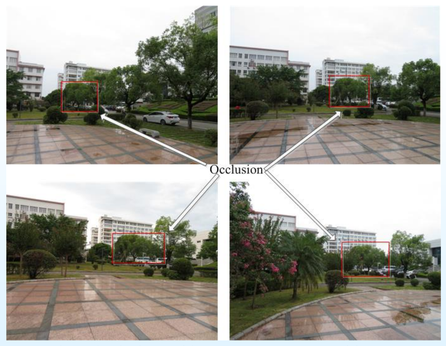


Fig. 1 Occlusions with respect to camera positions.

## Related Work

Learning method:

- 1 is full visibility and to 0 when the occluders are blocking light transport. (Fredo Durand, et al.)
- A progressive convolutional neural network training paradigm to enforce the attention shift by the trainable attention model. (Juefei-Xu et al.)

Our goal:

- Design a method for improving the capturing information and the rendering quality of views with occlusion for the IBR.

## Proposed Methods

An occlusion probability (OCP) model.

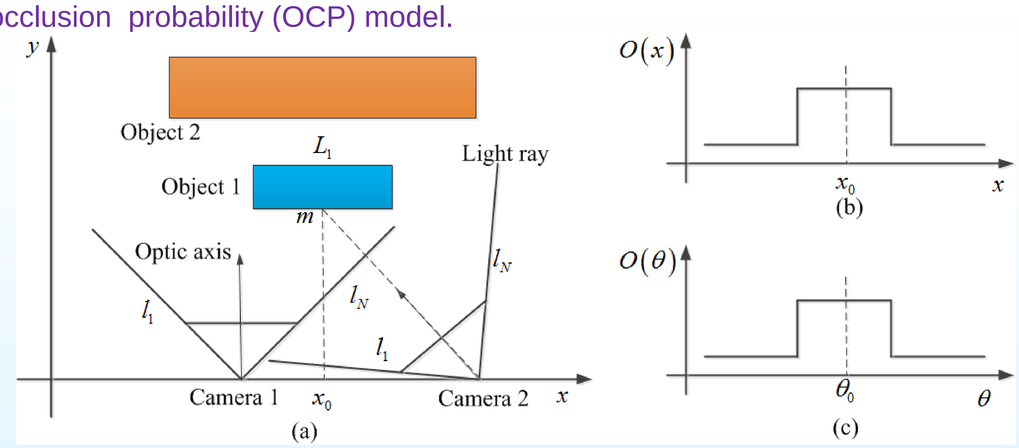


Fig. 2 Occlusion degree changes with camera configuration

- The variation of occlusion degree can be roughly approximated similar a Gauss function as

$$P(x) = o(\kappa - x)e^{\left(-(x-x_0)^2/2\right)}$$

- The probability of occlusion with the direction can be expressed as

$$P(\theta) = o(\kappa - \theta)e^{\left(-(\theta-\theta_0)^2/2\right)}$$

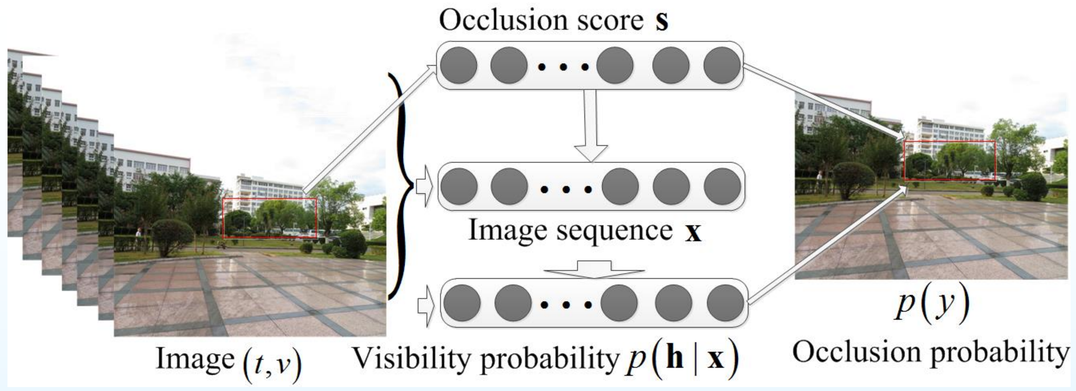


Fig. 3 Framework of OCP model with the positions and directions of camera..

Parameterization

- The visibility function can be rewritten as

$$p(\mathbf{h} \mid \mathbf{x}) = \angle(\mathbf{x}, \boldsymbol{\theta}, \textstyle\sum) = o(\kappa - x)o(\kappa - x)\exp\left(-\frac{(x-x_0)^2}{2}\right)\cdot\exp\left(-\frac{(x-\theta_0)^2}{2}\right)$$

- The visible layer can be represented based on restricted boltzmann machine as

$$p(\mathbf{S}, \mathbf{X}, \mathbf{h}^1, \cdots, \mathbf{h}^L) = \left(\prod_{l=1}^{L} p(\mathbf{s}^l, x^l \mid \mathbf{h}^l)\right)\left(\prod_{l=1}^{L-2} p(\mathbf{h}^l \mid \mathbf{h}^{l+1})\right) \times p(\mathbf{h}^{L-1}, \mathbf{h}^L, \mathbf{s}^L, \mathbf{x}^L)$$

## Results

Validation of the spectrums.

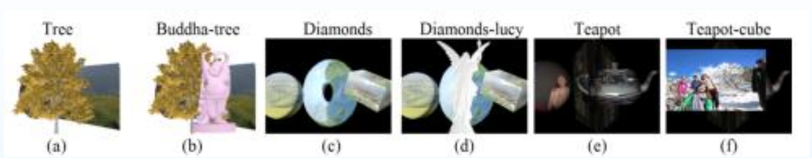


Fig. 4 Examples of occlusions for different data-sets.

- From the experimental results, we can see that when captured position is at the object center, the occlusion reaches the maximum.

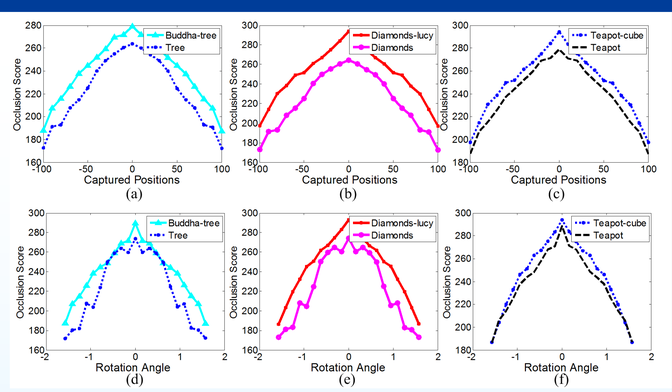


Fig. 5 The occlusion scores changes with the position and direction of the camera for the six data-sets.


Fig. 6 The actual occlusion scenes. (a) Campus; (b) statue; (c) scene acquisition device.

## Comparison results

- The ghosting occurs because the scene complexity such as the leafage and irregular shape which are challenging econstructed accurately. However, when using the proposed occlusion model, the ghosting and aliasing in the rendered views will decreases..

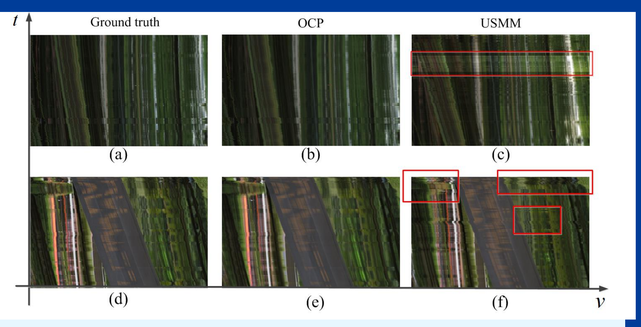


Fig. 7 The EPI for the ground truth and the reconstruction using the proposed algorithm and a competitor algorithm, consecutively. (a1)-(a3) The EPI for campus; (b1)-(b3) the EPI for statue.

## Conclusion

- A novel OCP model to improve the rendering quality of views with occlusion.
- A probability density model is applied to obtain the scores of visibility are modeled as hidden variables.
- Based on the occlusion probability, capturing/reconstruction techniques to visualize/manipulate can be improved.