DEEP VIEW SYNTHESIS FROM SPARSE PHOTOMETRIC IMAGES

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Render real scenes

[Einarsson et al. 2006]

[Dong et al. 2010]

[Schwartz et al. 2011]

[Zickler et al. 2005]
Appearance of a scene

• Geometry

[Furukawa and Ponce 2008]

[Newcombe et al. 2011]

• Materials

[Xu et. al 2016]

[Li et. al 2018]
Appearance of a scene

- Geometry
- Materials

- Realistic rendering

[Einarsson et al. 2006]
[Dong et al. 2010]
[Schwartz et al. 2011]
Appearance of a scene

- Geometry
- Materials

Realistic rendering

- Einarsson et al. 2006
- Dong et al. 2010
- Schwartz et al. 2011
Appearance of a scene

Light Transport Function

• Realistic rendering

[Einarsson et al. 2006]
[Dong et al. 2010]
[Schwartz et al. 2011]
Light transport acquisition

Light Transport Function

[Matusik et al. 2002]
Image-based relighting

Our relighting under environment map illumination

[Xu et al. 2018]
Light transport acquisition for changing view

Sparse input views

Novel view appearance
Novel view synthesis

- Unstructured views
- Small baseline
- Natural illumination
Sparse sampling for light transport acquisition

• Large baseline

• Controlled lighting
Preview

- Large baseline
- Controlled lighting
Our Result

Ground Truth
Acquisition configuration

• Sparse

• Good coverage
Acquisition configuration

- Icosahedron
  - 12 vertices
  - 20 faces
  - Symmetric
Acquisition configuration

Icosahedron
Acquisition configuration

Icosahedron
Acquisition configuration

Icosahedron
Acquisition configuration

Icosahedron
Synthetic scenes

Geometry:
Procedurally Generated Objects

Reflectance:
Adobe Stock Material

Material images courtesy: Allegorithmic and Adobe Stock
Synthetic scenes

Geometry:
Procedurally Generated Objects

Reflectance:
Adobe Stock Material

Our Synthetic Scene
Overview

Input views

CNN
Overview

Input views

CNN
Overview

Input views

CNN

Novel view
Overview

Input views

Novel view
Plane sweep volume

Input views

Novel view
Plane sweep volume

Input views

Novel view
Plane sweep volume

Input views

Novel view
Plane sweep volume

Input views  Novel view
Plane sweep volume

Input views

Novel view
Plane sweep volume

Input views

Novel view
Plane sweep volume

Input views

Novel view
Plane sweep volume

Input views

Novel view
Plane sweep volume

Input views

Novel view
Plane sweep volume

Input views

Novel view
Attention maps

Plane sweep volume

Views

Depth
Attention maps

Plane sweep volume

Visibility-aware attention maps
Attention maps

Plane sweep volume

Visibility-aware attention maps

Visibility-aware attention maps

Depth

Views
Attention maps

Plane sweep volume

Attention-masked volume

CNN
Our network

- CNN
  - Correspondence Branch
  - Shading Branch

- Infer geometry (depth)
- Infer attention maps
- Infer shading
- Aggregate appearance
Correspondence branch

- Infer geometry (depth)
- Infer attention maps
Correspondence branch

Input images

Views

(2D CNN)

Feature Extractor
(2D CNN)

Feature maps

Views
Correspondence branch

Input images

Feature maps

Views

Feature Extractor (2D CNN)

Plane sweep
Correspondence branch

- Input images
- Feature maps
- Feature Extractor (2D CNN)
- Plane sweep
- Correspondence Predictor (3D CNN)

(3D CNN)
Correspondence branch

Input images

Feature maps

Visibility-aware attention maps

Depth probability maps

Feature Extractor (2D CNN)

Plane sweep

Correspondence Predictor (3D CNN)
Correspondence branch

- Input images
- Feature maps
- Visibility-aware attention maps
- Depth probability maps

Feature Extractor (2D CNN)
Plane sweep
Correspondence Predictor (3D CNN)
Shading branch

Visibility-aware attention maps

Depth probability maps

Input images
Shading branch

Visibility-aware attention maps

Plane sweep volume

Attention-masked volume

Depth probability maps

(3D CNN)

Per-plane image

Shading Predictor (3D CNN)
Shading branch

Visibility-aware attention maps

Plane sweep volume

Attention-masked volume

Depth probability maps

Per-plane image

Shading Predictor (3D CNN)
Corr-Branch + Shade-Branch

- Feature Extractor (2D CNN)
- Correspondence Predictor (3D CNN)
- Visibility-aware attention maps
- Depth probability maps
- Plane sweep volume
- Shading Predictor (3D CNN)
- Per-plane image
Real Data Results
Data #1: input images and corresponding views
Data #1: compare with [Penner and Zhang 2017] using the same inputs

Penner and Zhang 2017
Our results
Ground truth (Some views are occluded)
Data #1: compare with [Sun et al. 2018] using the same inputs

Sun et al. 2018

Our results

Ground truth
(Some views are occluded)
Data #2: input images and corresponding views
Data #2: our results and ground truth

Inputs and viewing directions

Our results

Ground truth (Some views are occluded)
Data #3: input images and corresponding views
Data #3: our results and ground truth

Inputs and viewing directions

Our results

Ground truth
(Some views are occluded)
Data #4: input images and corresponding views
Data #4: our results and ground truth

Inputs and viewing directions

Our results

Ground truth (Some views are occluded)
Novel view relighting
Novel view relighting
Data #4: our novel view relighting results

Our synthesized images

Relighting

Environment map 1
Multi-view stereo

Input images

Reconstruction
Data #2: Multi-view stereo from synthesized images

Reconstruction from 56 captured images
Reconstruction from 56 synthesized images using our method
Reconstruction from 56 synthesized images using our method (rendered with color)
Limitations

- Highly specular objects
  - 64 x 64 image crops for training
  - Limited receptive field
Limitations

• Highly specular objects
  • 64 x 64 image crops for training
  • Limited receptive field

• Highly non-convex shape
  • Visible from 1 or 2 views
Conclusion

Our Result

Ground Truth

Visibility-aware attention maps
Conclusion

Our Result

Ground Truth

Novel view relighting

Multi-view stereo

Multi-view stereo
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