An Image Degradation Model for Depth-augmented Image Editing

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Common Image Edits

- move objects
- change perspective
  (update occlusion)
Questions (we ask)

1. Can we simplify the operations?

2. Can we predict how well the ops will perform?
Painting Depth

[Oh et al. 2001]
 Editing Vanishing Lines

[Carroll et al. 2010]
Cuboids or Generalised Cylinders

[Zheng et al. 2012]

[Chen et al. 2013]
Use Actual 3D Models

[Kholgade et al. 2014]
so what changed?
New Hardware
Depth Sensors

missing depth
Depth Sensors
Depth Sensors
single image
RGB + (bad) depth
Depth-augmented Image Edits

RGB channels

depth channel

Challenges
(i) bad/missing depth
(ii) RGB-D misalignment
Example: Parallax Video
Overview

Scene Decomposition and Layering

Image Degradation Model

Applications
Overview

Scene Decomposition and Layering

Image Degradation Model

Applications
RGB-D Image Quality
Coupled Processing

segmentation

primitive extraction

depth completion/reassignment
RGB-D to Layered Representation
RGB-D to Layered Representation
Scene Decomposition

\[ \mathbf{n} \cdot \mathbf{p} + d = 0 \]
Scene Decomposition

\[ E_u(i) := \frac{1}{N} \sum_{i=1}^{N} (|p_i \cdot n_{\text{prim}} + d_{\text{prim}}|) + \lambda \exp(-|n_{\text{sp}} \cdot n_{\text{prim}}|) \]

\[ E_p(i, j) := \alpha \exp(-||c_i - c_j||) + \beta \exp(-|d_i - d_j|) \]
Scene Decomposition

infilled depths

RGB layers
Billboarding

planar objects

non-planar objects
Occlusions

identify occlusion with primitives
clipping with primitives
RGB-D Image
image → \{ (\text{imageSegment}_i, (\text{n}_i, \text{d}_i), \text{clipping}_i, \text{depth}_i) \}
More Examples
Overview

Scene Decomposition and Layering

Image Degradation Model

Applications
Degradation Model

(images with common normalisation)
Degradation Model: spatial
Degradation Model: texture

\[
texture(i, j) := \frac{1}{N} \sum_{x=-k:1:k} \sum_{y=-k:1:k} |I(i + x, y + j) - I(i, j)|
\]
Degradation Model

Spatial

Texture

Low

High

Hennessey et al., SGP 2015 | An Image Degradation Model for Depth-augmented Image Editing
Overview

Scene Decomposition and Layering

Image Degradation Model

Applications
1. Layer-assisted DoF
Output: DoF Parallax Photo
2. Novel View Synthesis
Predicting Image Degradation

degradation map (low)

synthesized image (low degradation)

degradation map (high)

synthesized image (high degradation)
Results

Input: RGB-D Image
Limitations

User scribbles for thin segments

Bleeding across edges (pixel level)

No perceptual limits
Limitations
Conclusion and Future Work

scene abstraction
coupled segmentation, proxy fitting, primitive assignment

an image degradation model

camera path planning + assisted editing

other primitives
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