An Image Degradation Model for Depth-augmented Image Editing

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Images

Common Image Edits

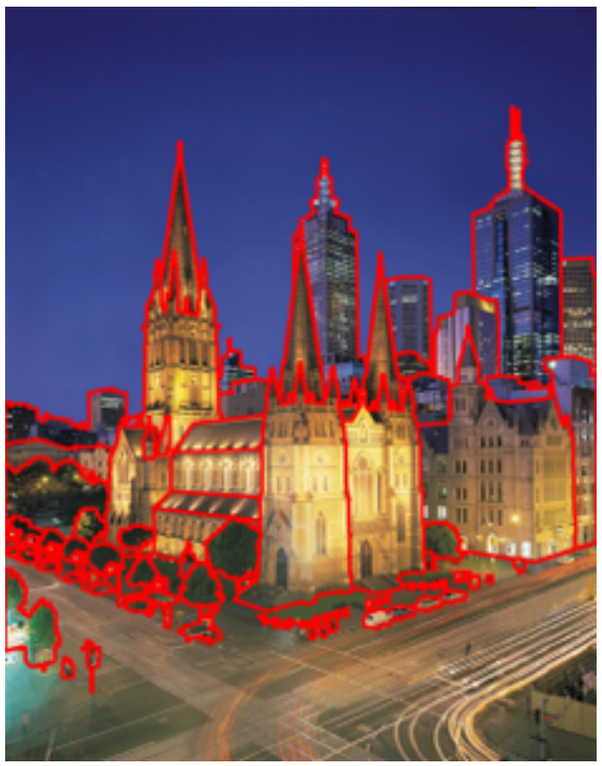
move objects
change perspective
(update occlusion)

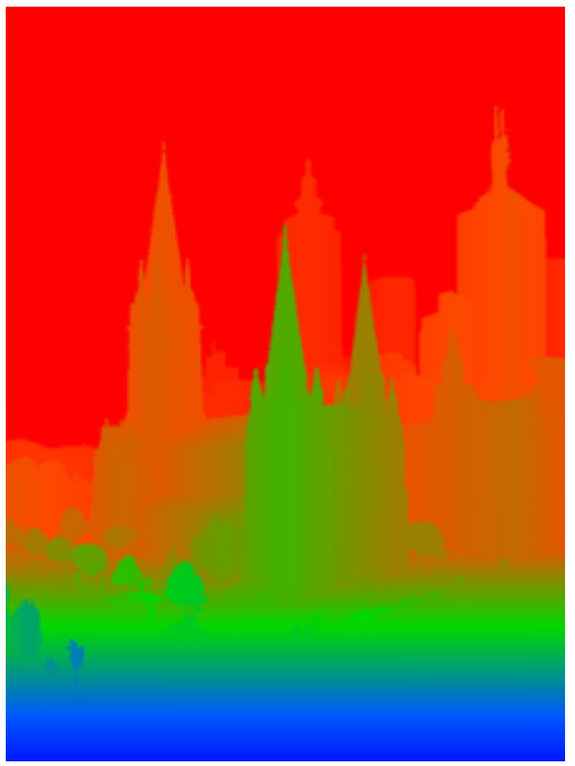
Questions (we ask)

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

Input

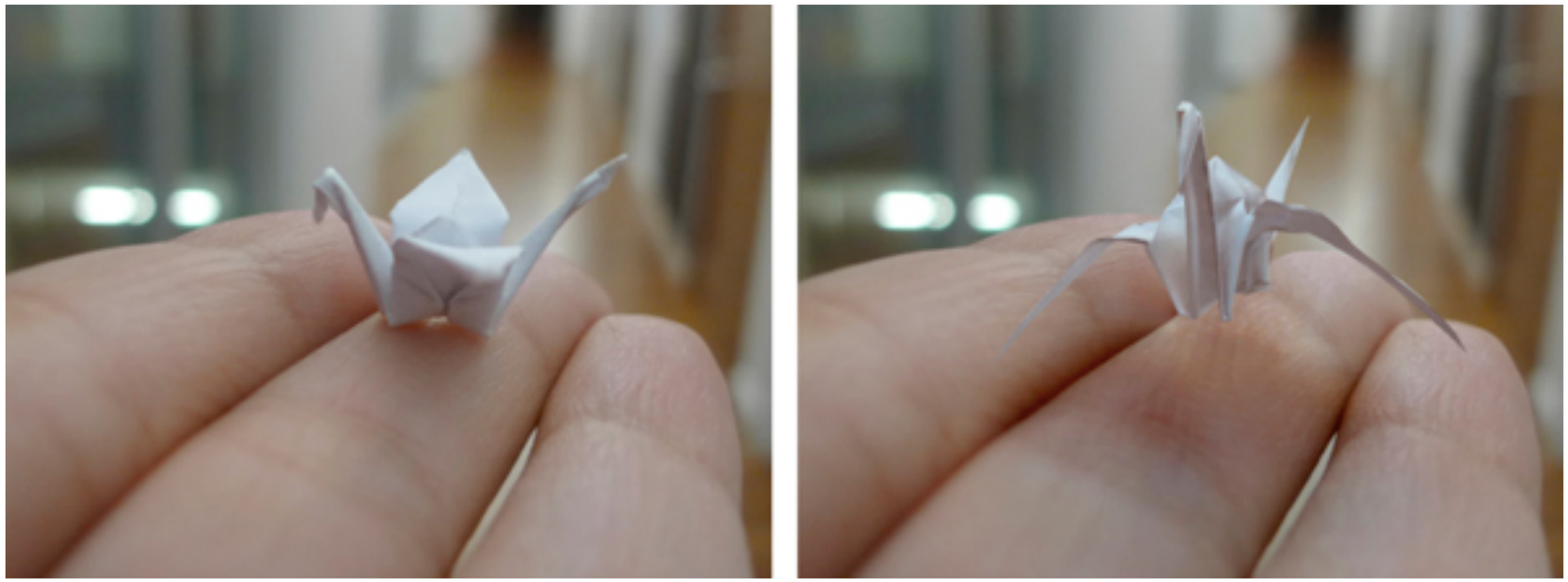
[Carroll et al. 2010]

Cuboids or Generalised Cylinders

[Zheng et al. 2012]

[Chen et al. 2013]

Use Actual 3D Models

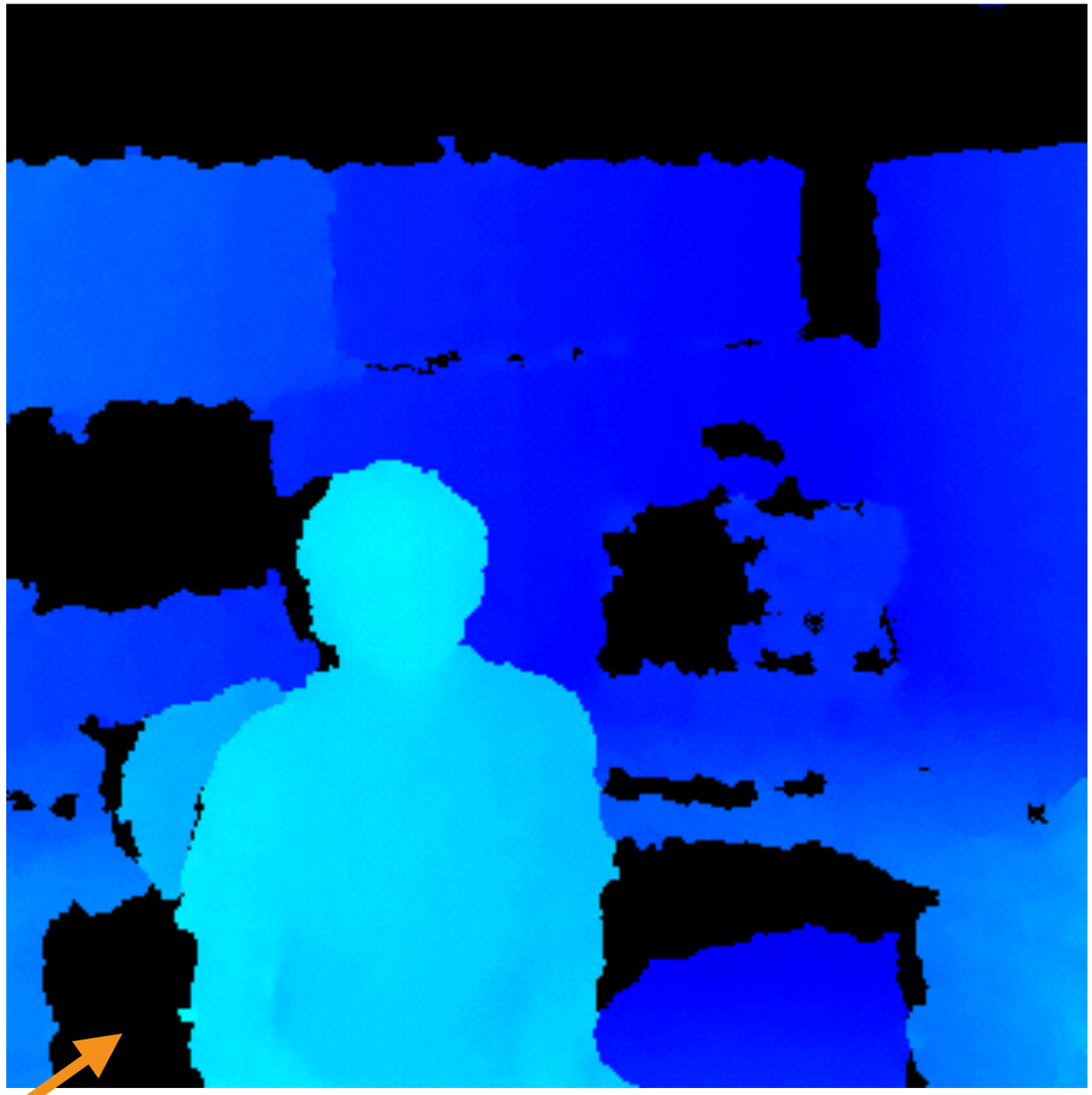


[Kholgade et al. 2014]

so what changed?

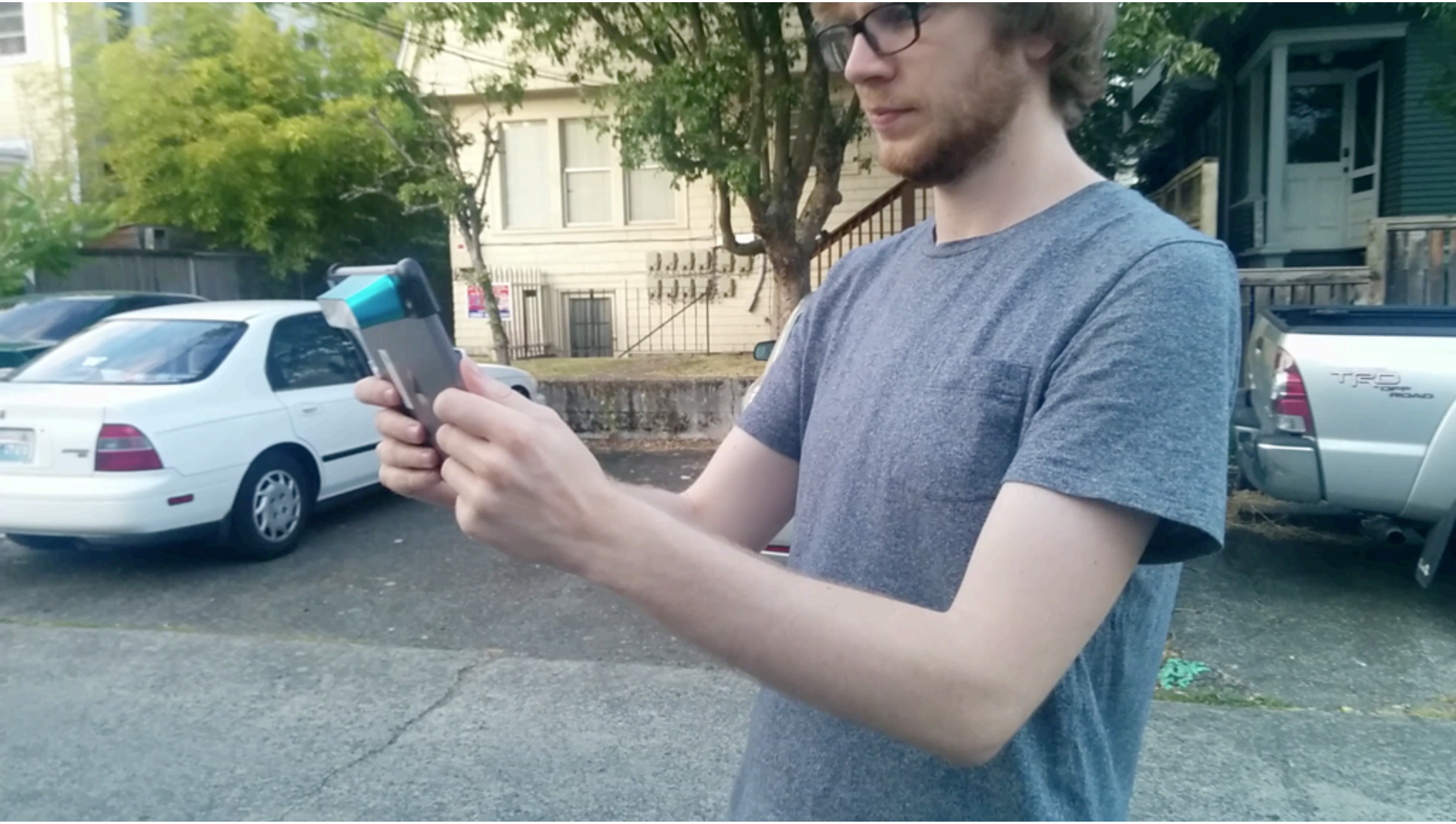
New Hardware

Depth Sensors



missing depth

Depth Sensors



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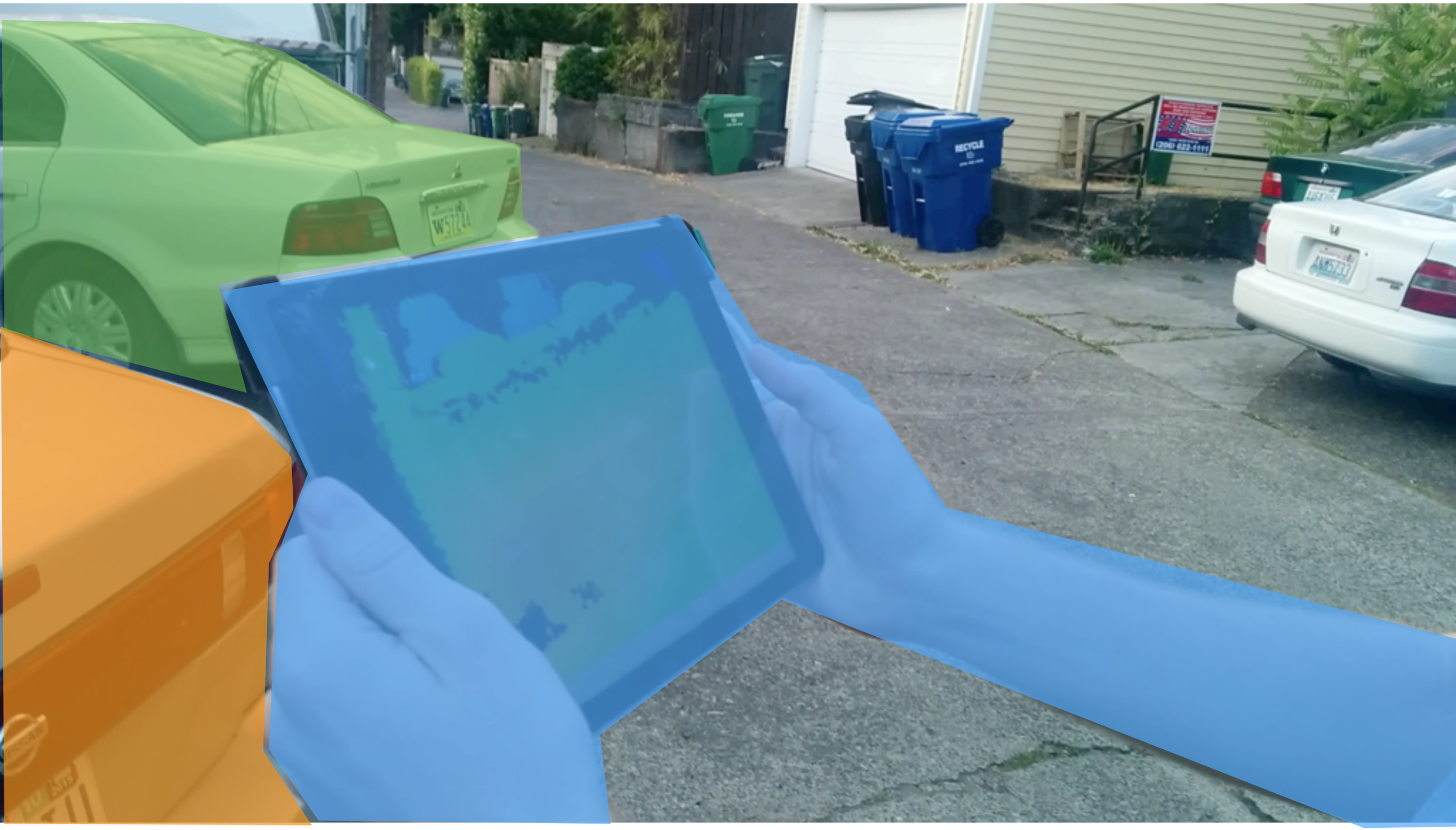
Depth Sensors

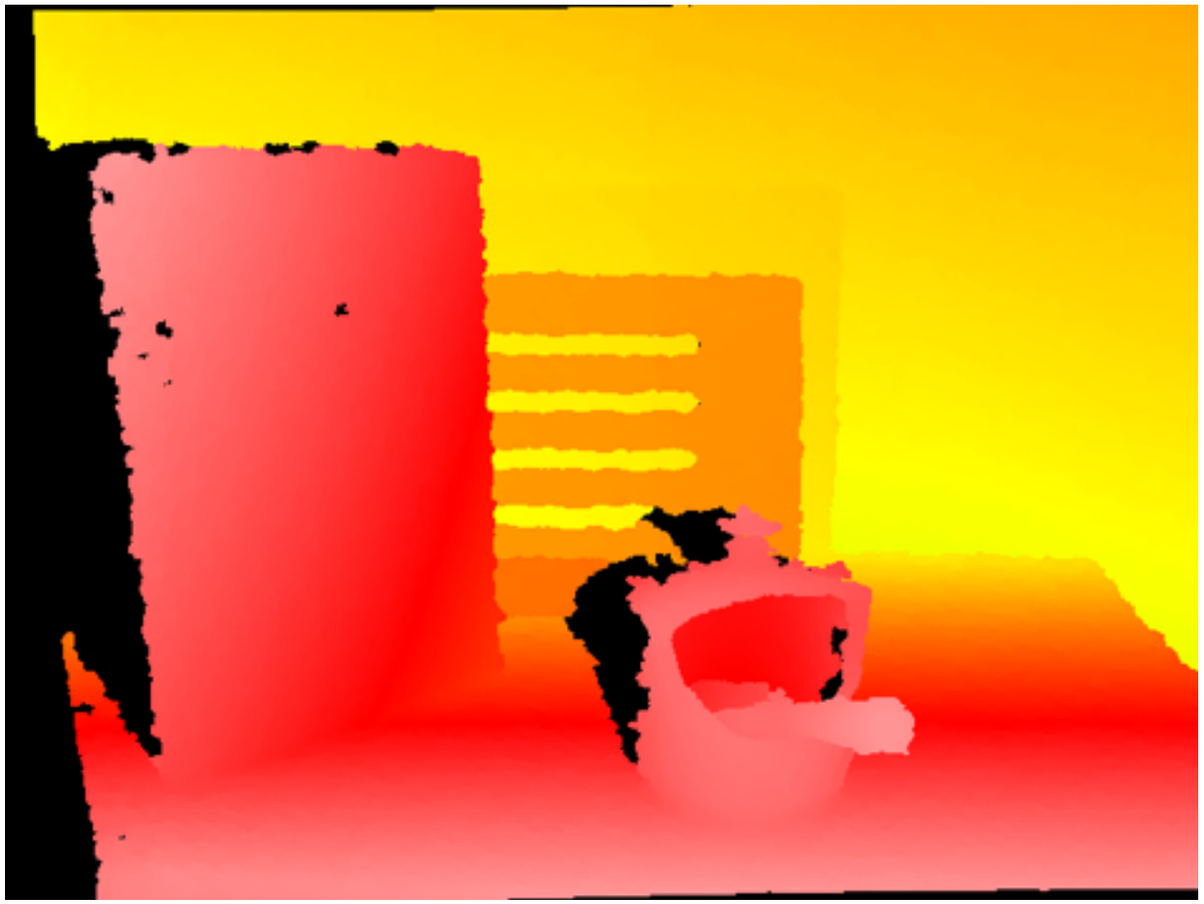


single image

RGB + (bad) depth

Depth-augmented Image Edits

RGB channels



depth channel

Challenges
(i) bad/missing depth
(ii) RGB-D misalignment

Example: Parallax Video

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Overview

Scene Decomposition and Layering

Image Degration Model

Applications

Overview

Scene Decomposition and Layering

Image Degration Model

Applications

RGB-D Image Quality

Coupled Processing

segmentation

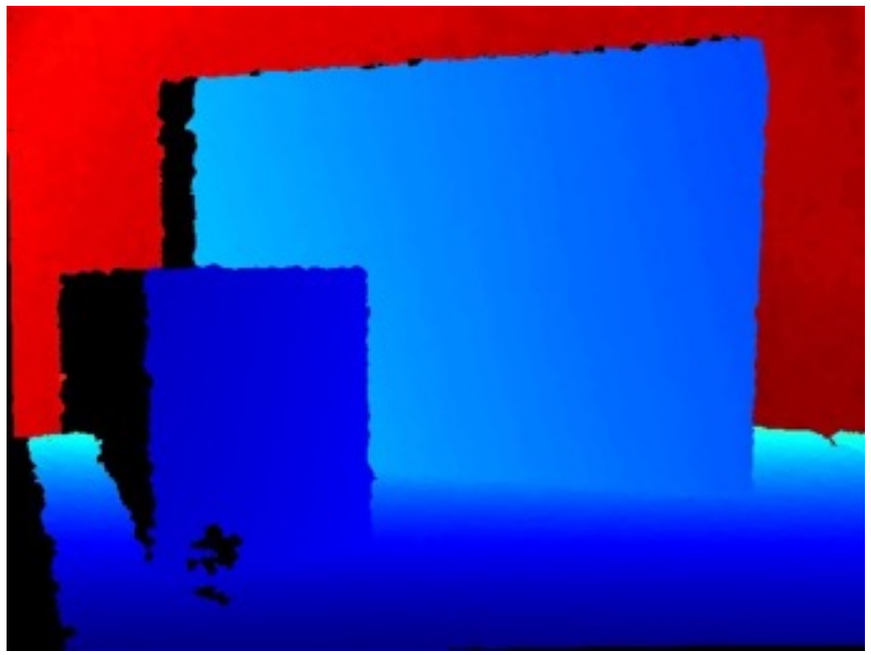
primitive extraction

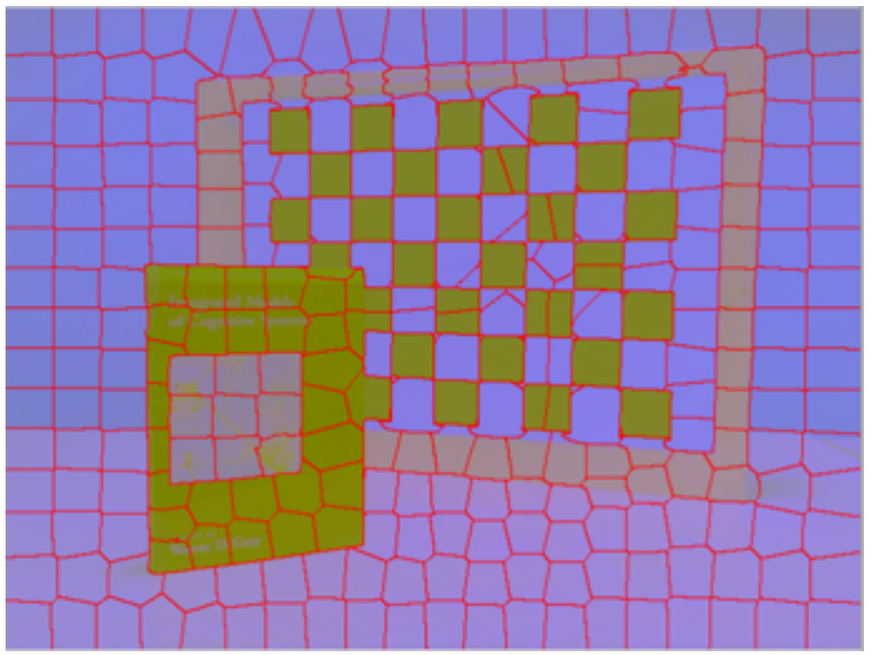
depth completion/
reassignment

RGB-D to Layered Representation

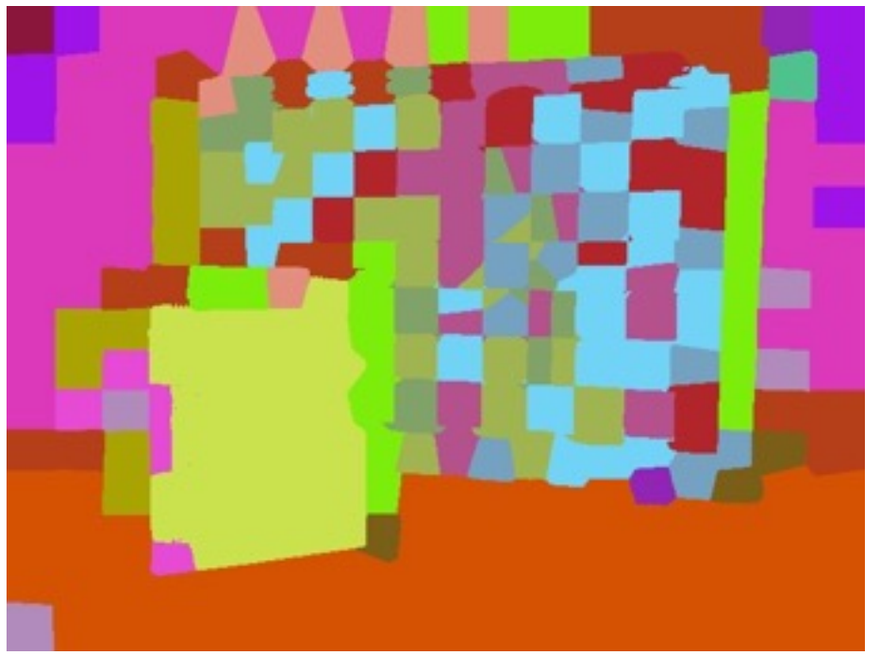
RGB-D to Layered Representation

Scene Decomposition

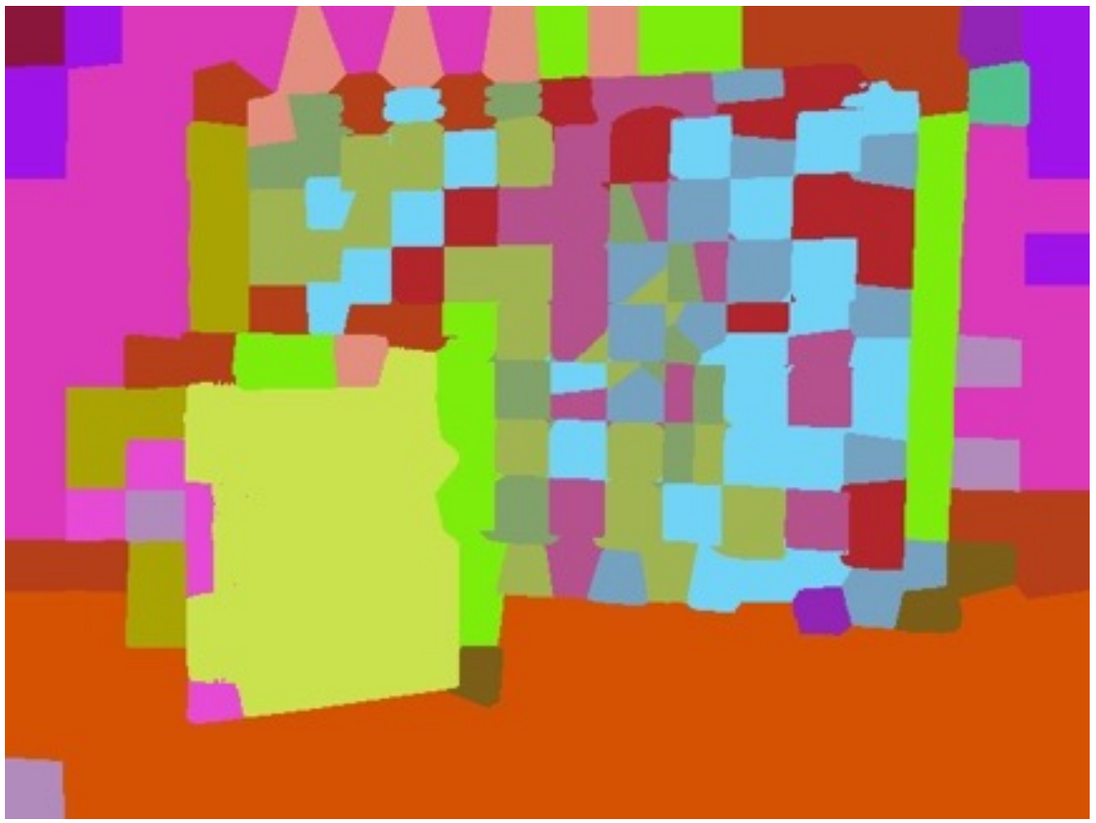


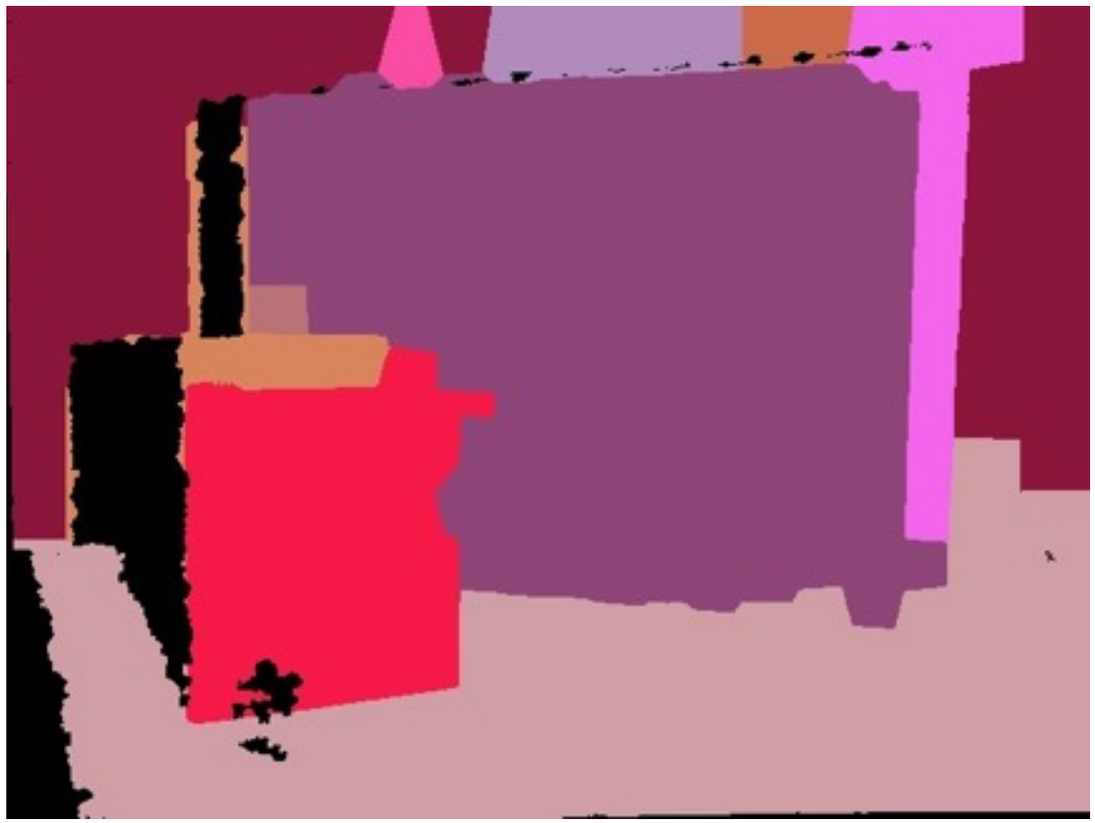


$$\mathbf{n} \cdot \mathbf{p} + d = 0$$



Scene Decomposition



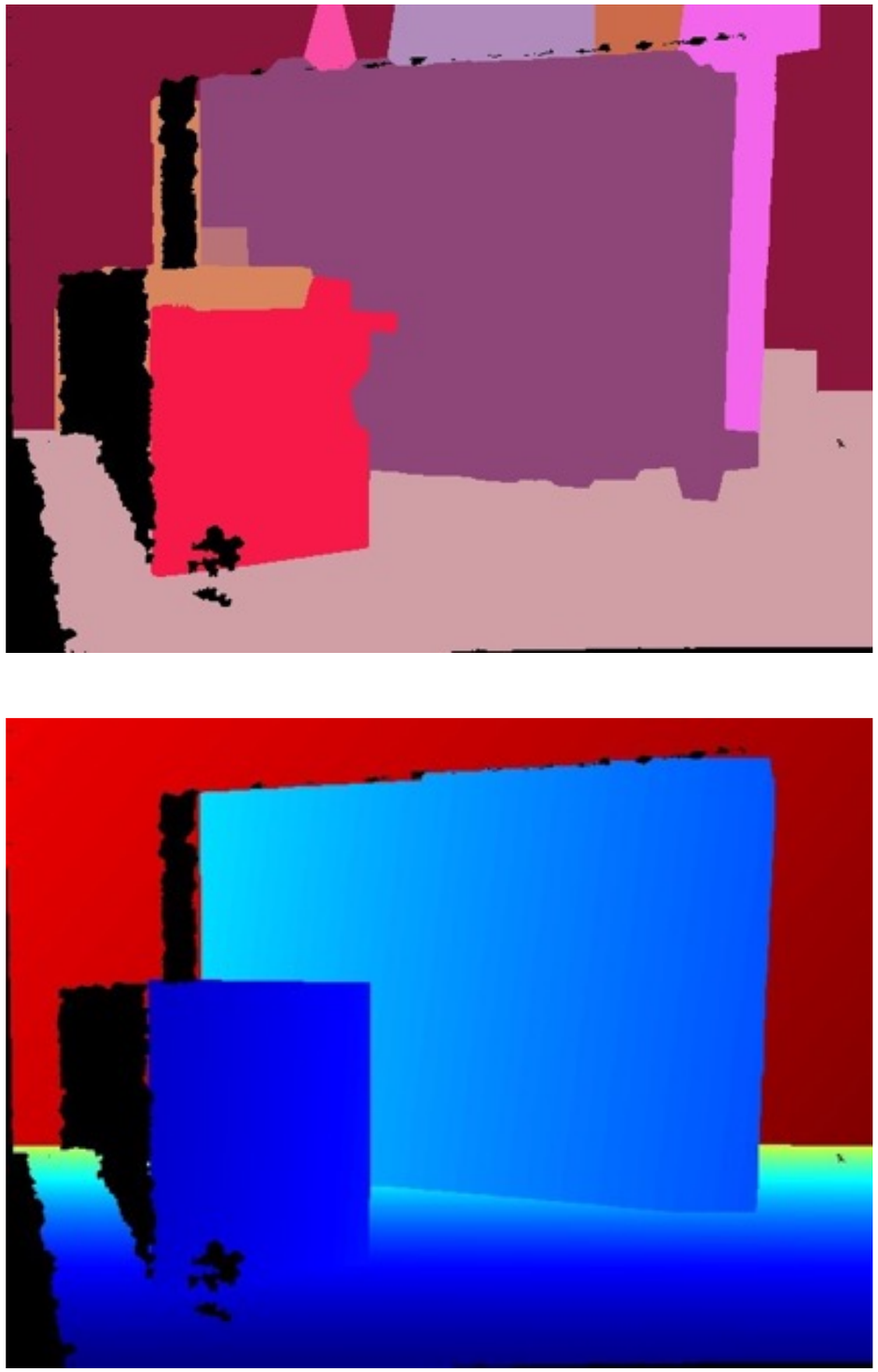


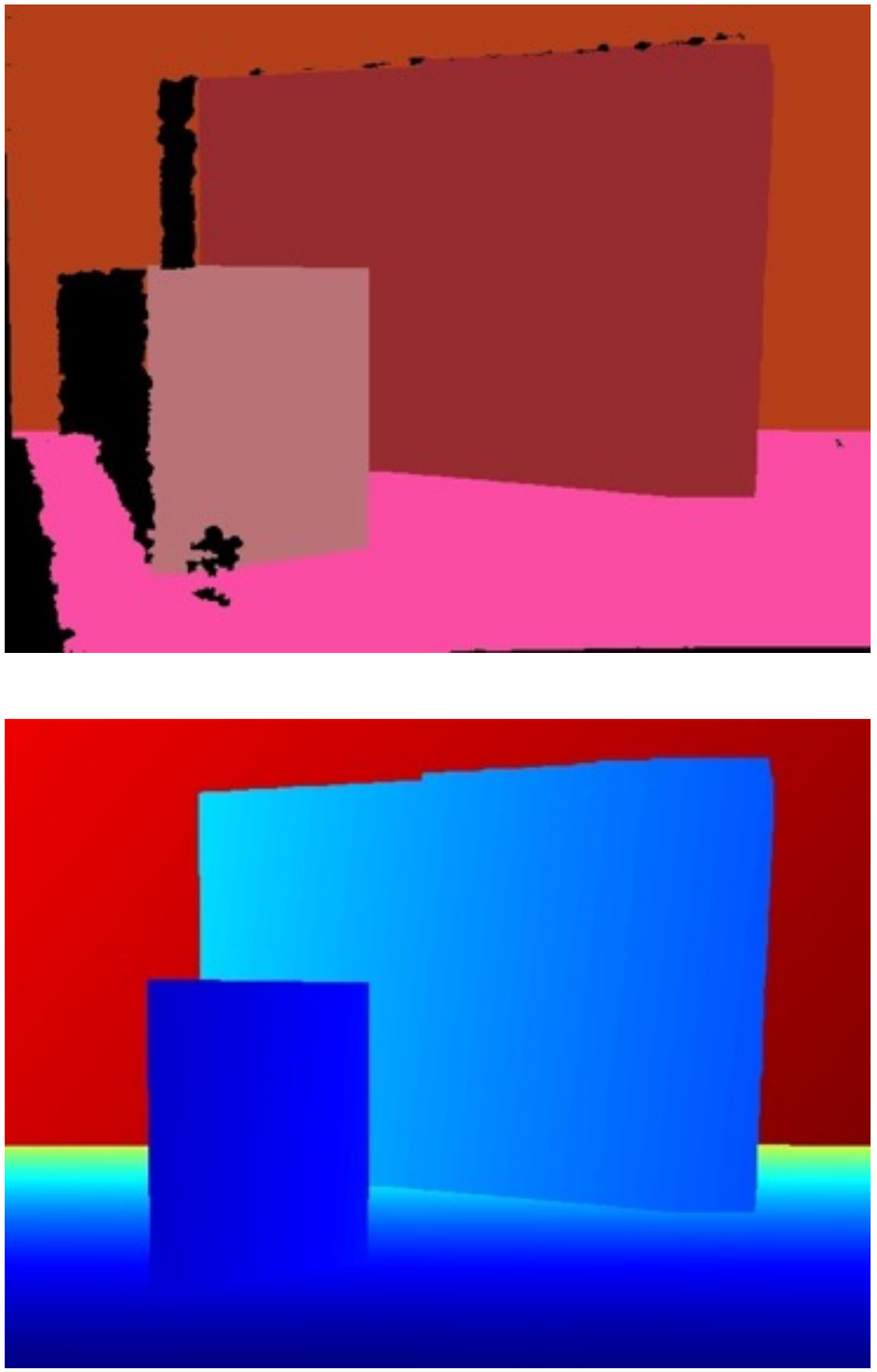
$$E_u(i) := \frac{1}{N}\sum_{i=1}^{N}(|\mathbf{p}_i \cdot \mathbf{n}_{\text{prim}} + d_{\text{prim}}|) + \lambda \exp(-|\mathbf{n}_{\text{sp}} \cdot \mathbf{n}_{\text{prim}}|)$$

+

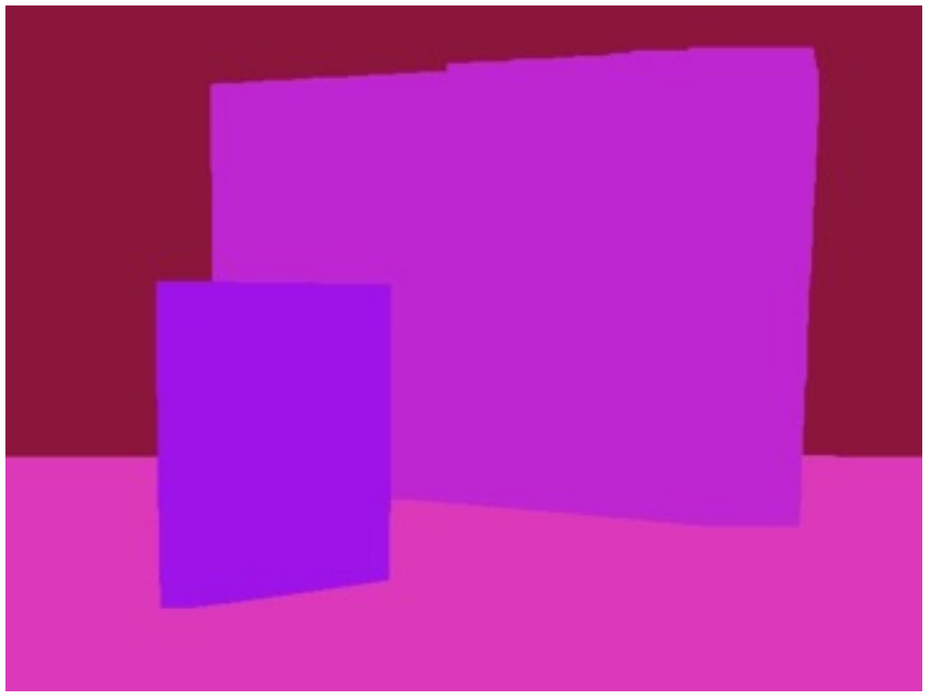
$$E_p(i,j) := \alpha \exp(-\|\mathbf{c}_i - \mathbf{c}_j\|) + \beta \exp(-|d_i - d_j|)$$

Scene Decomposition

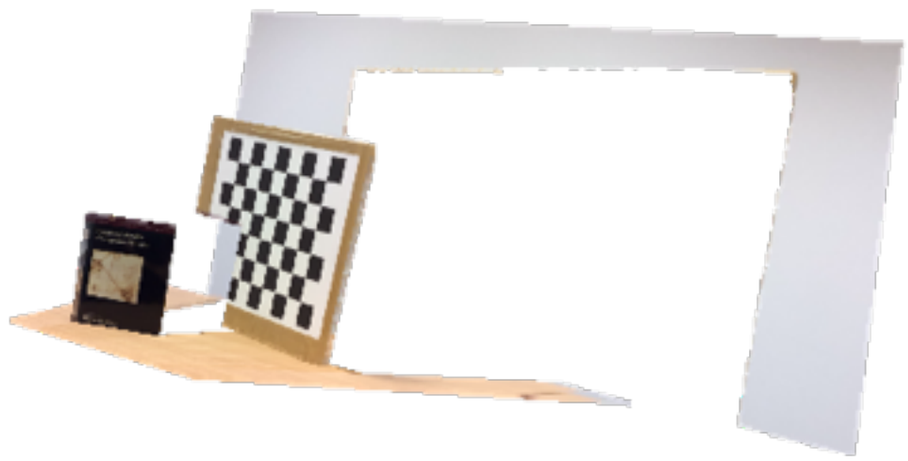




Scene Decomposition

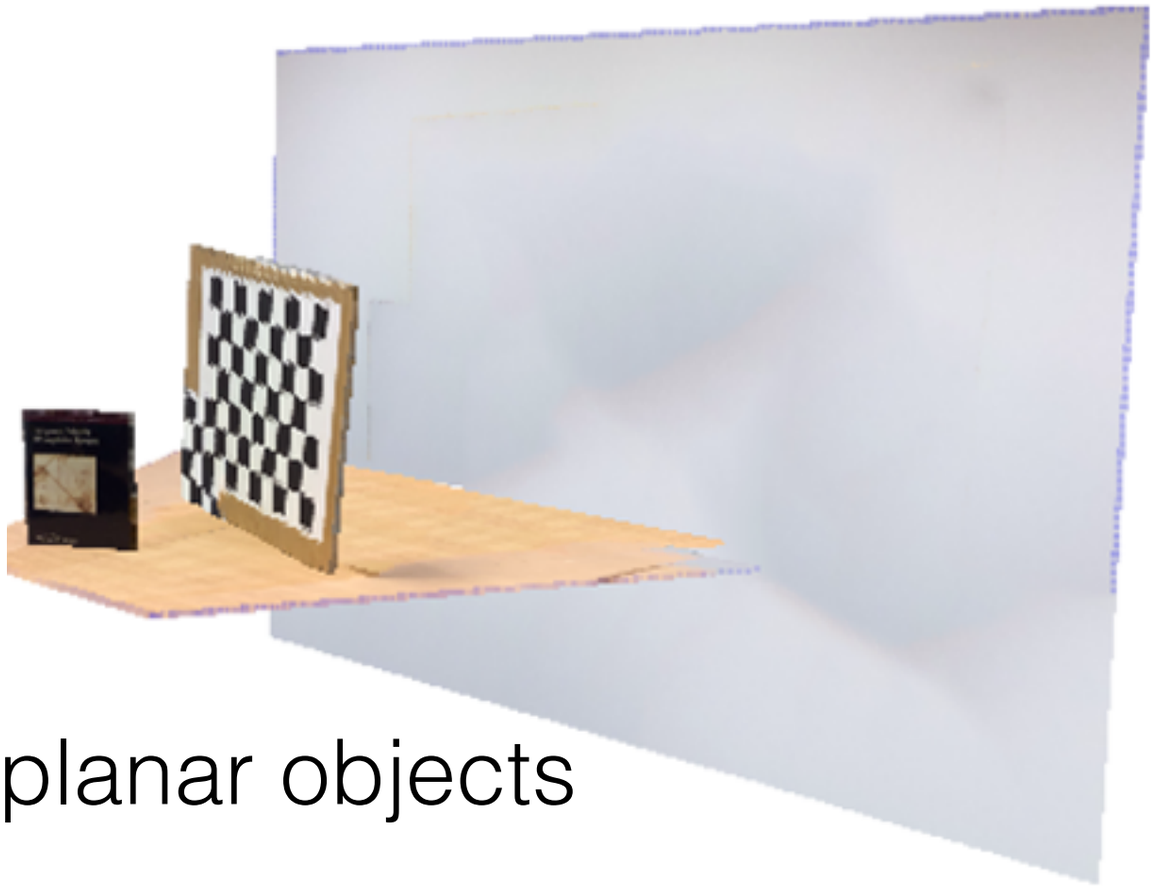


infilled depths



RGB layers

Billboarding



planar objects

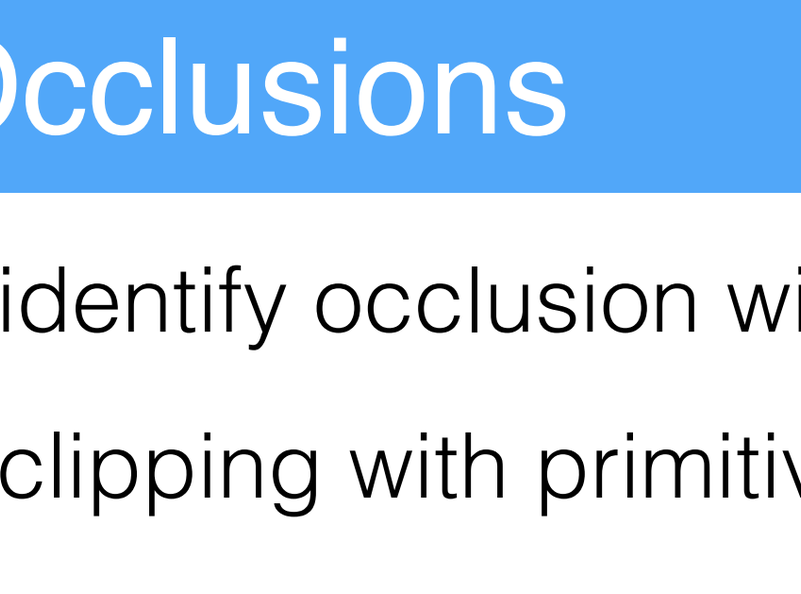
non-planar objects

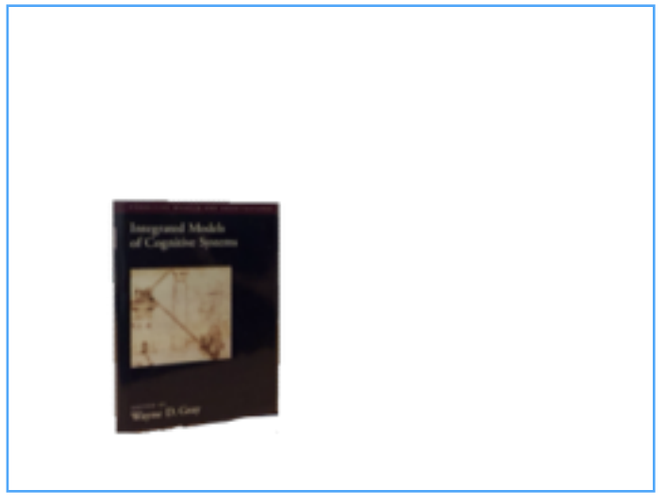
Primitive-assisted Infill

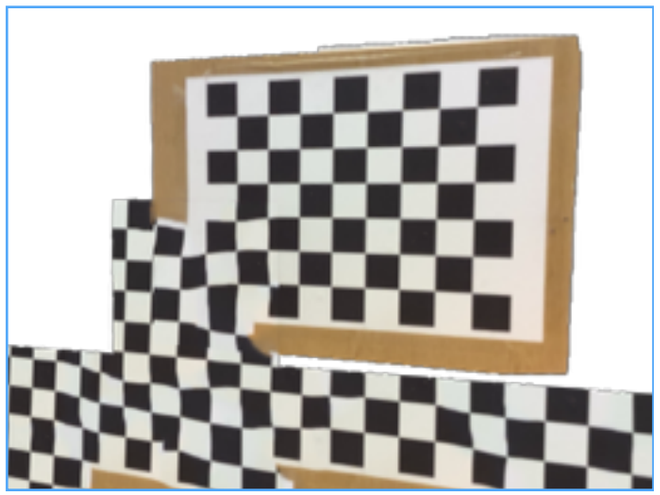
Occlusions

identify occlusion with primitives

clipping with primitives







RGB-D Image

RGB-D Image ⇨ Layered Rep.

$$\text{image} \rightarrow \{(\text{imageSegment}_i, (\mathbf{n}_i, d_i), \text{clipping}_i, \text{depth}_i)\}$$

More Examples

Overview

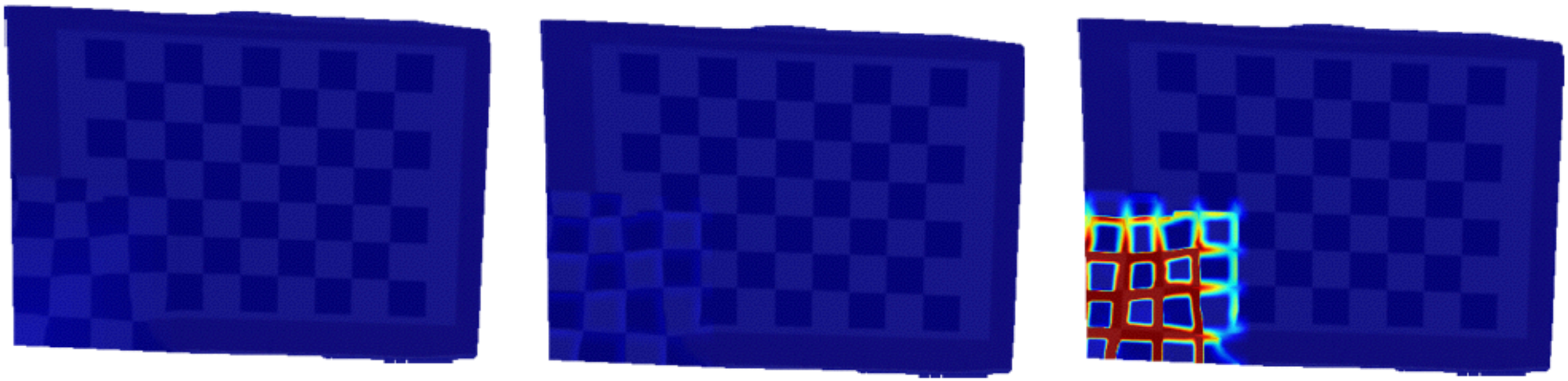
Scene Decomposition and Layering

Image Degration Model

Applications

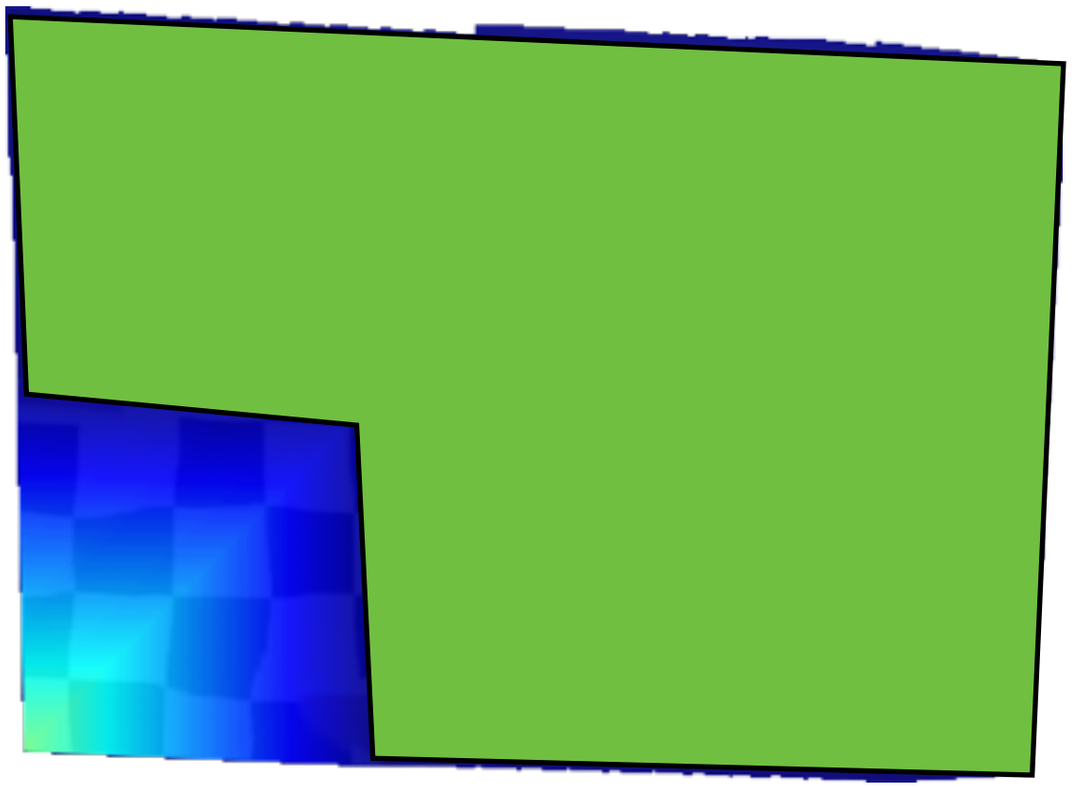
Degradation Model

low high

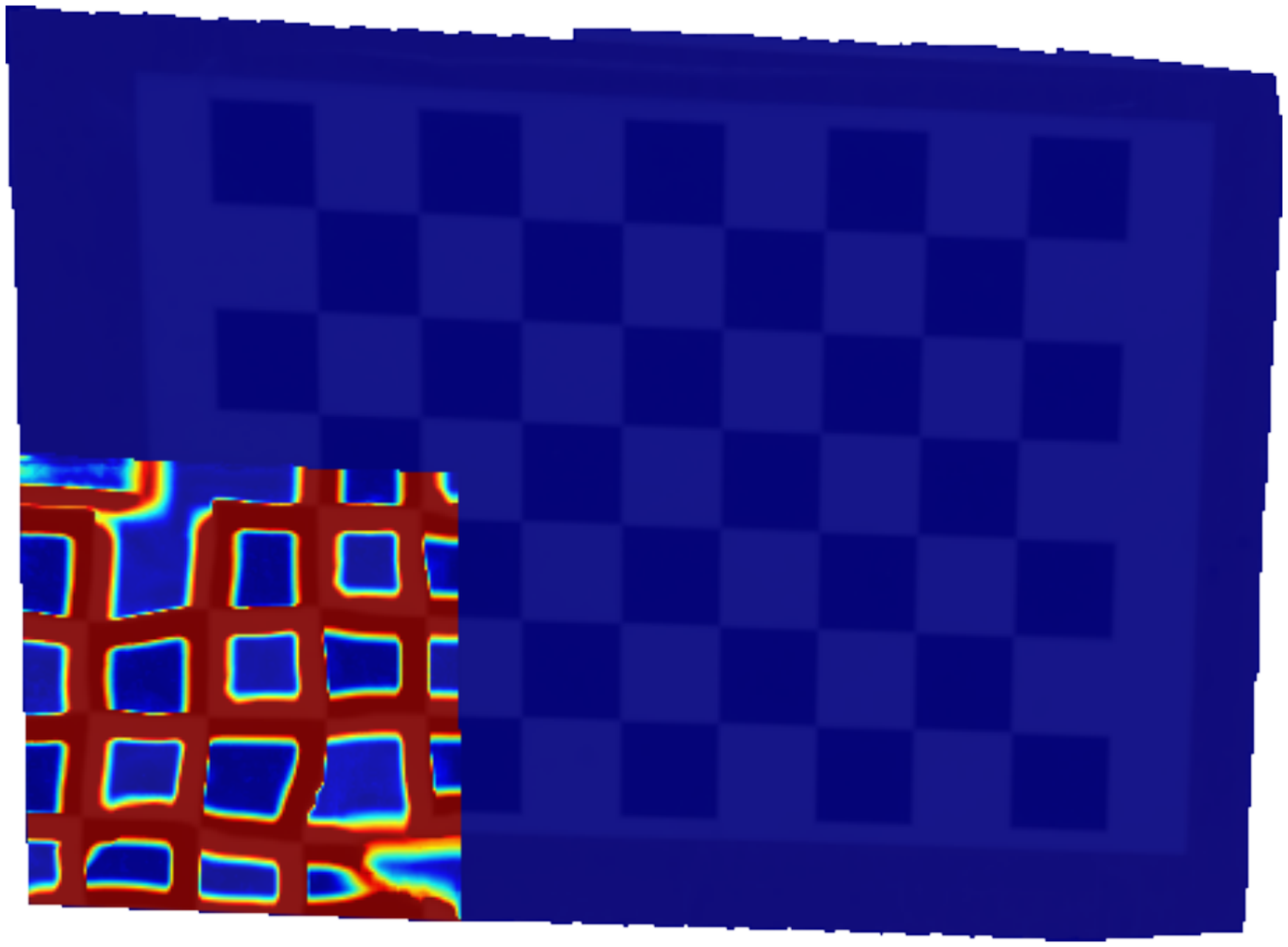


(images with common normalisation)

Degradation Model: spatial



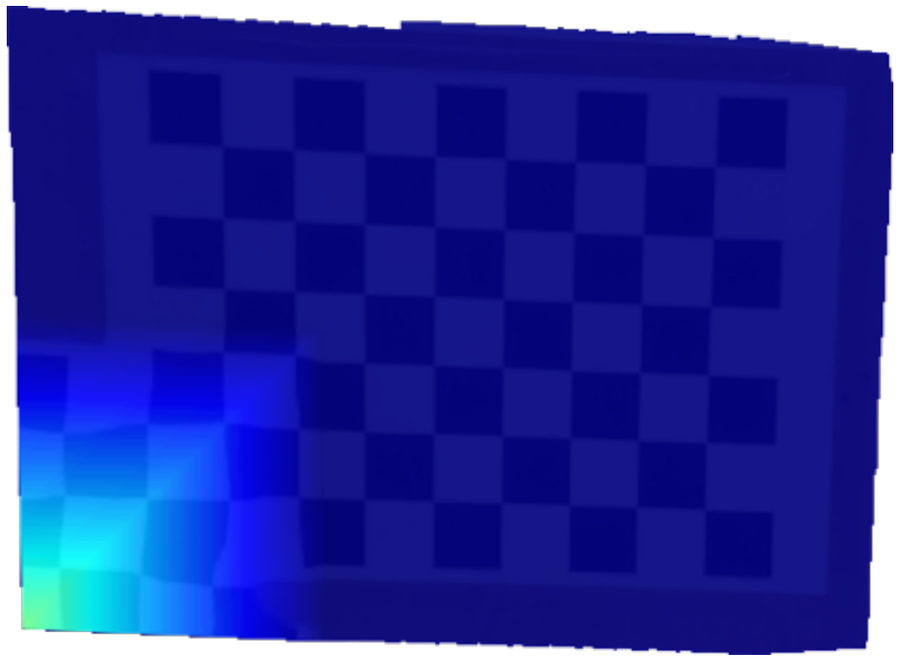
Degradation Model: texture



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

Degradation Model

spatial



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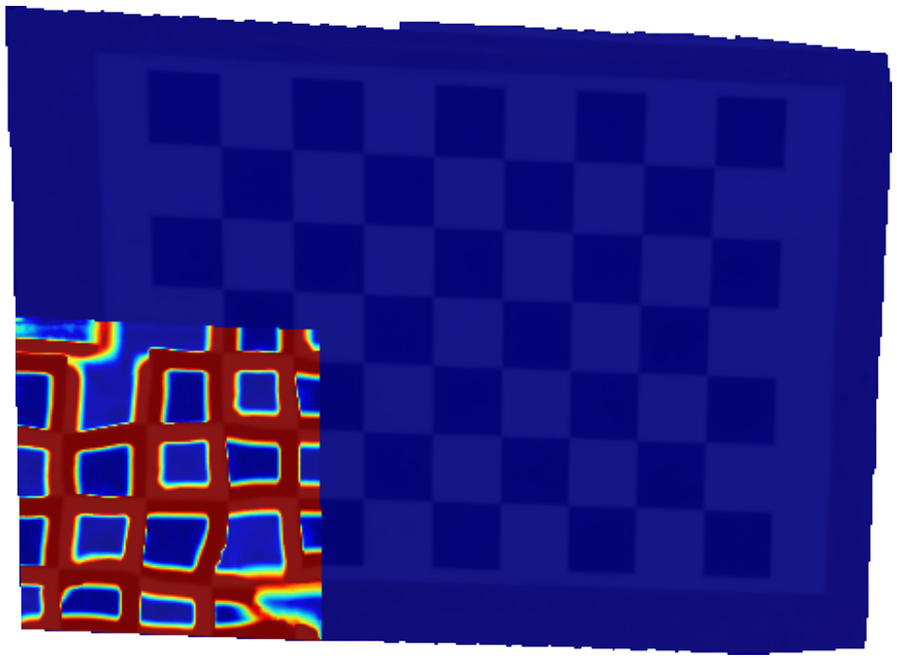
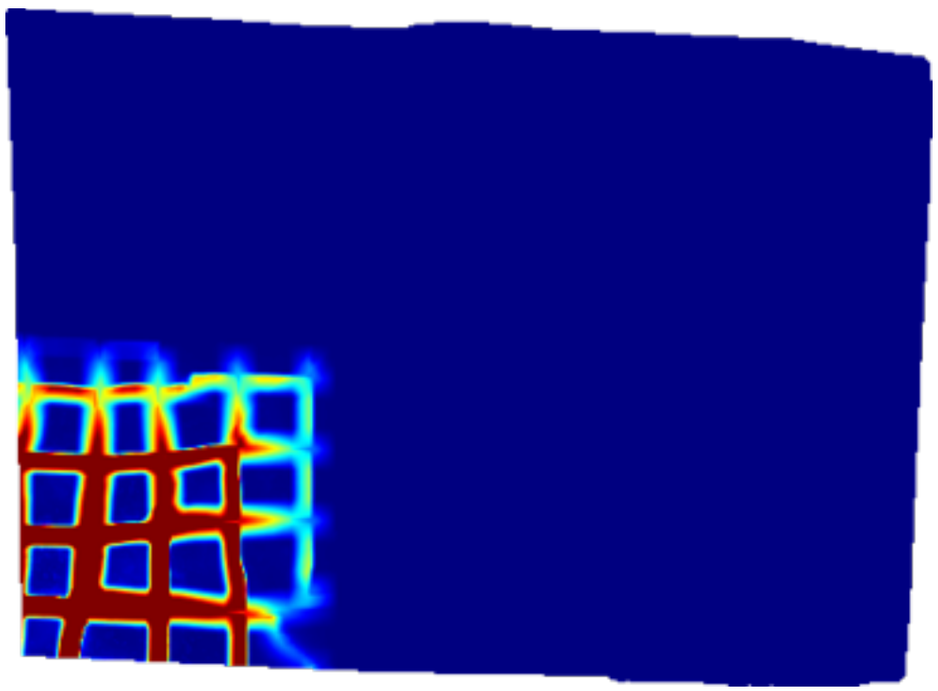


texture



low

high

Overview

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Image Degration Model

Applications

1. Layer-assisted DoF

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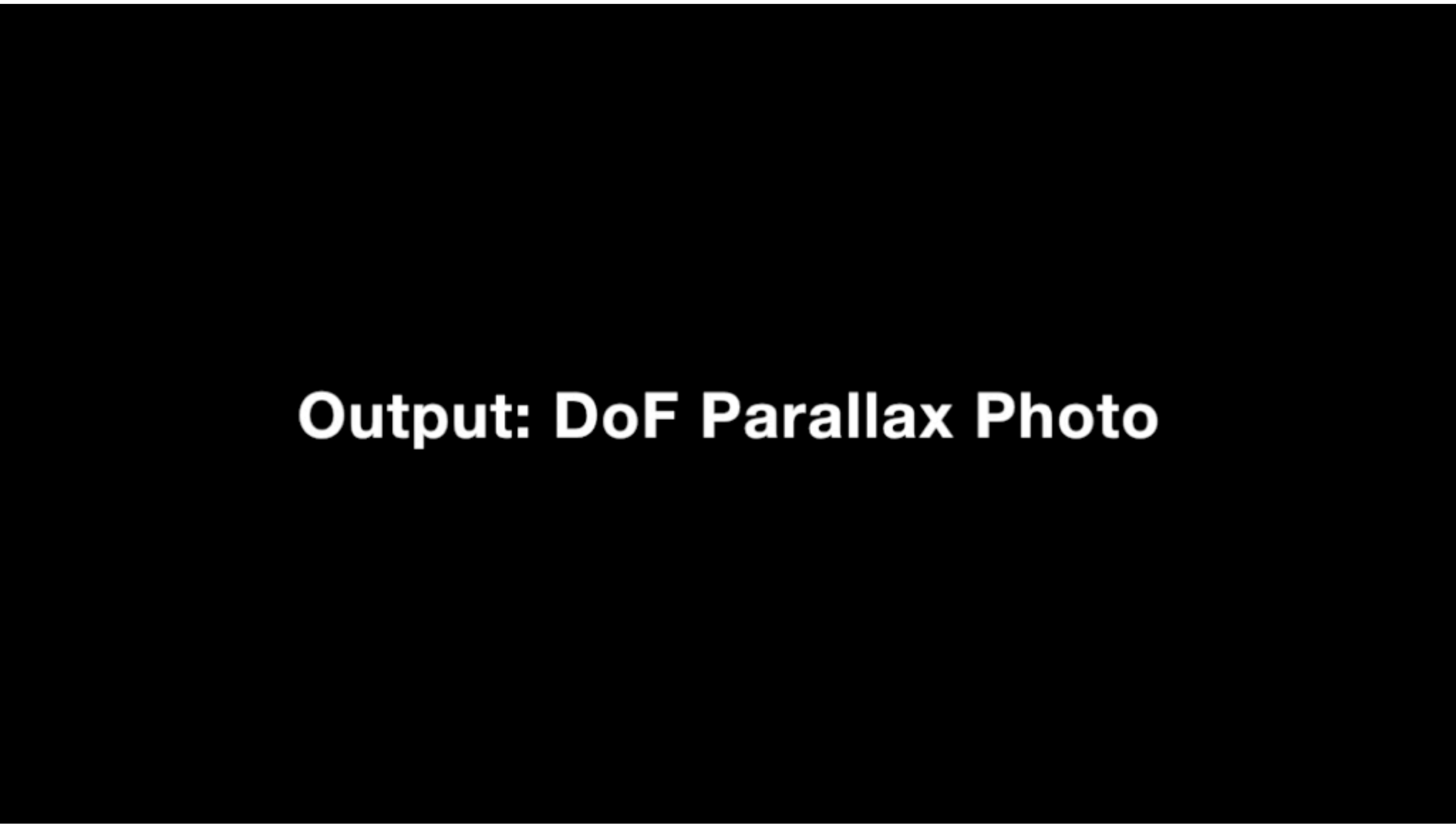
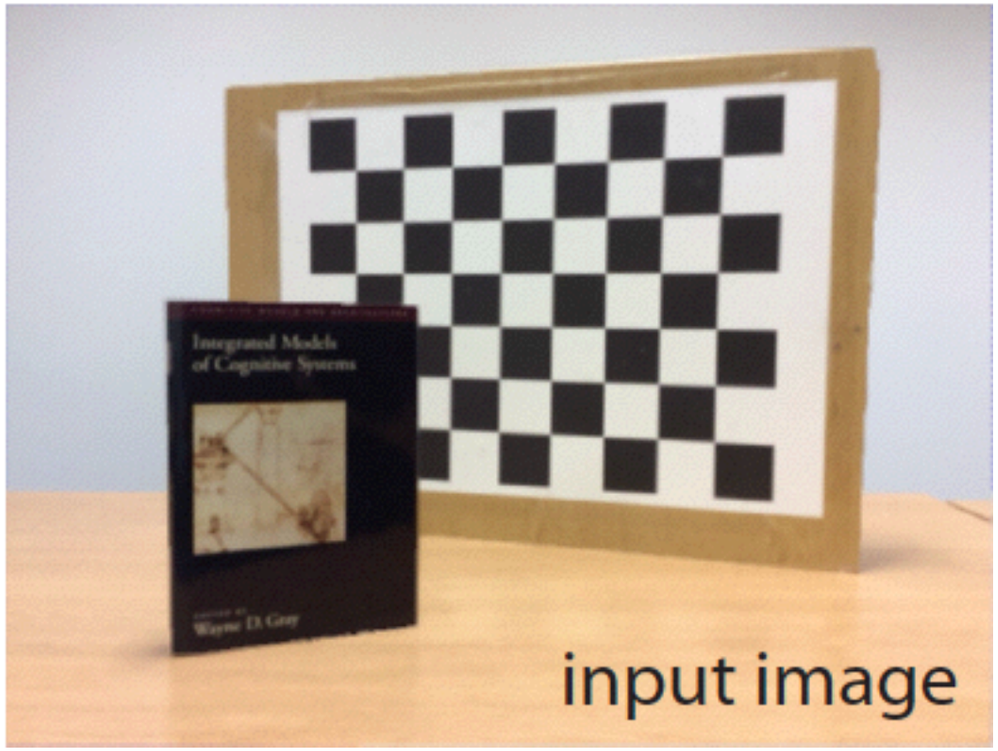
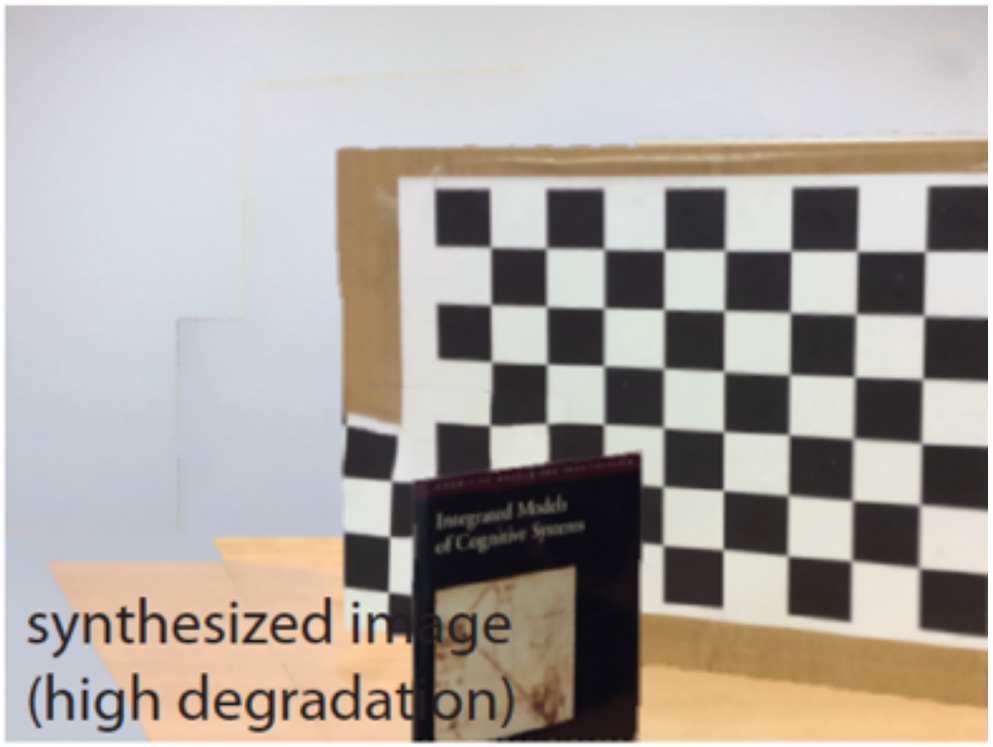
Depth-of-Field

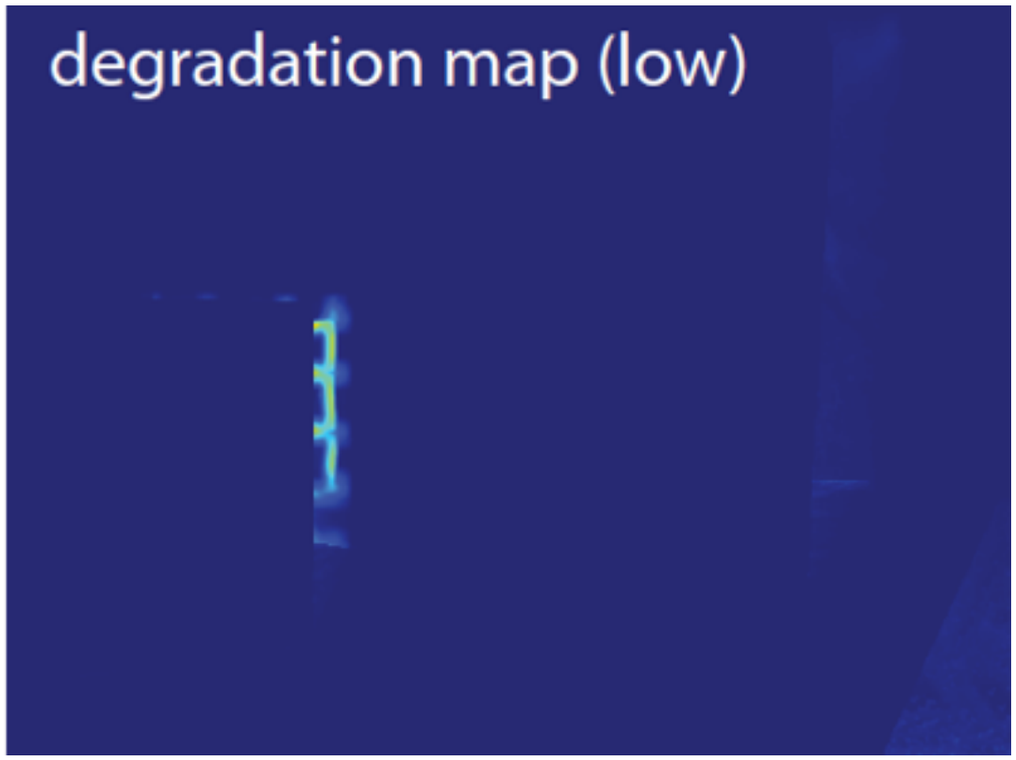


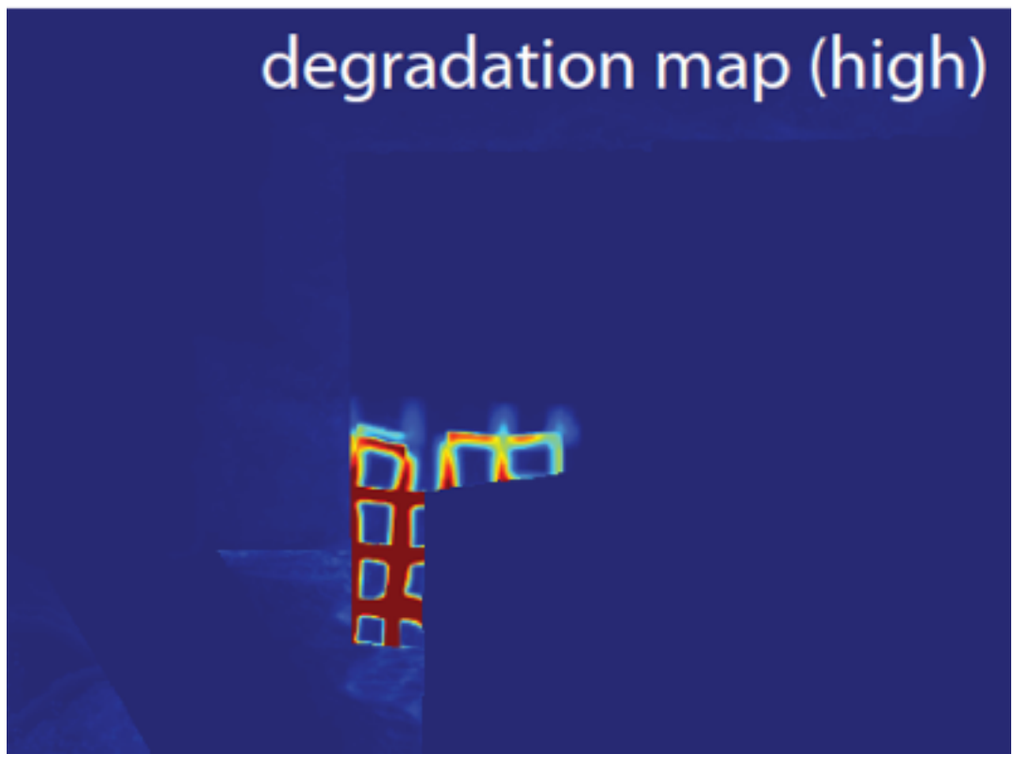
2. Novel View Synthesis

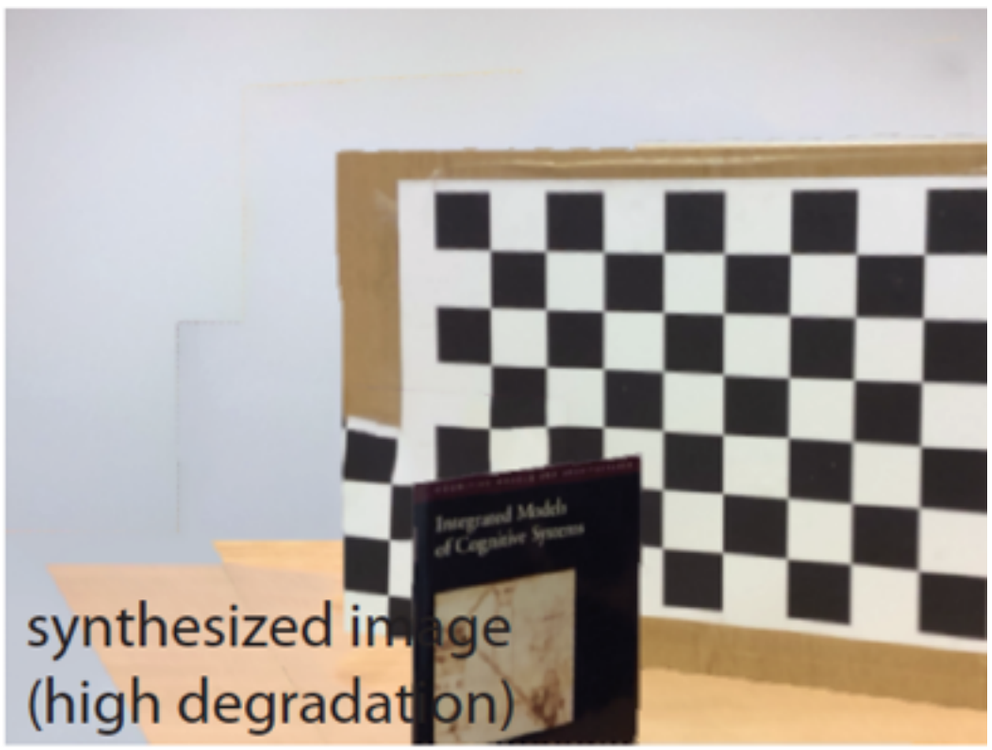




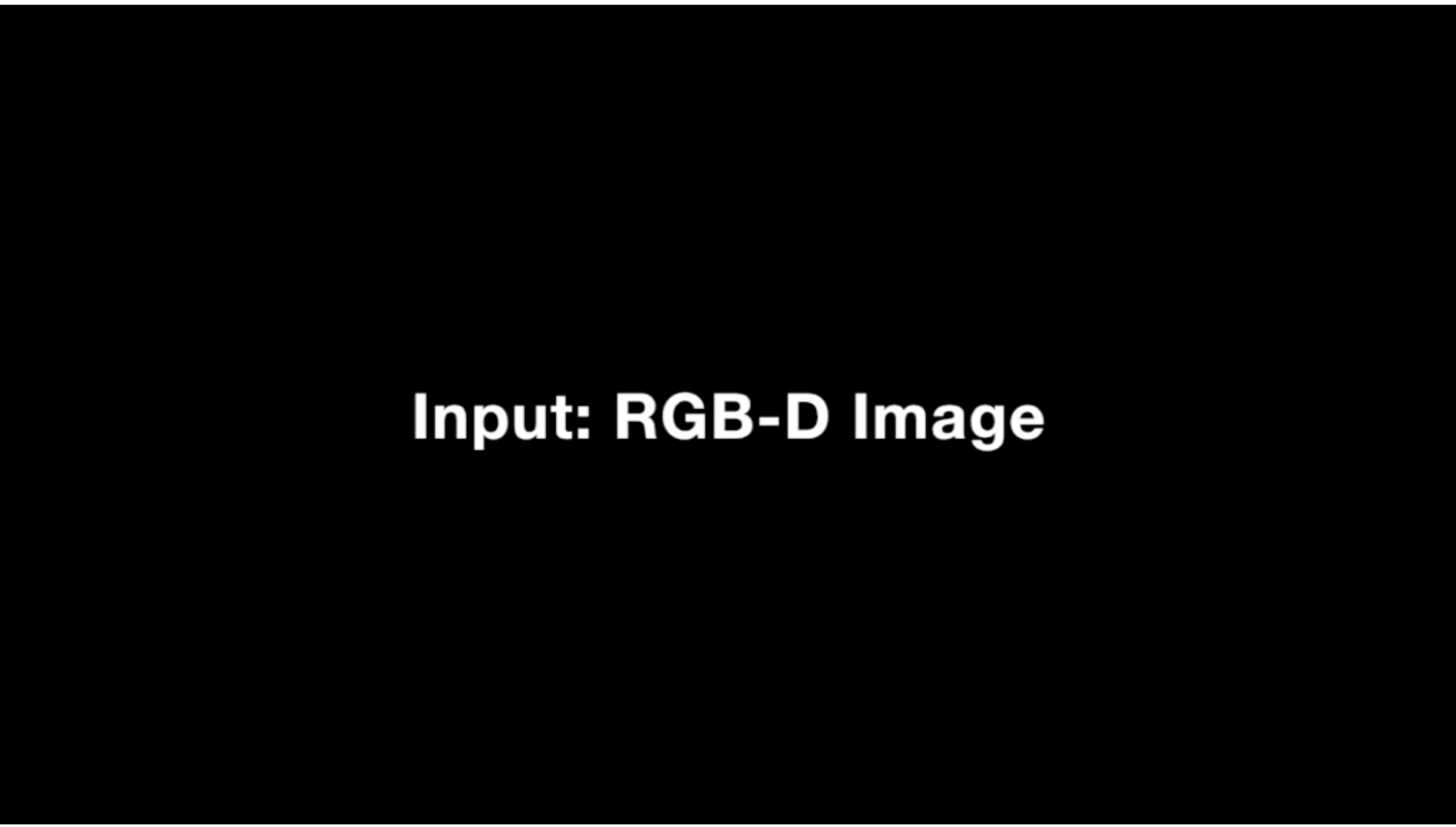
Predicting Image Degradation







Results



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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Moos Hueting

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Thank You

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