

Deep Image-Based Relighting from Optimal Sparse Samples

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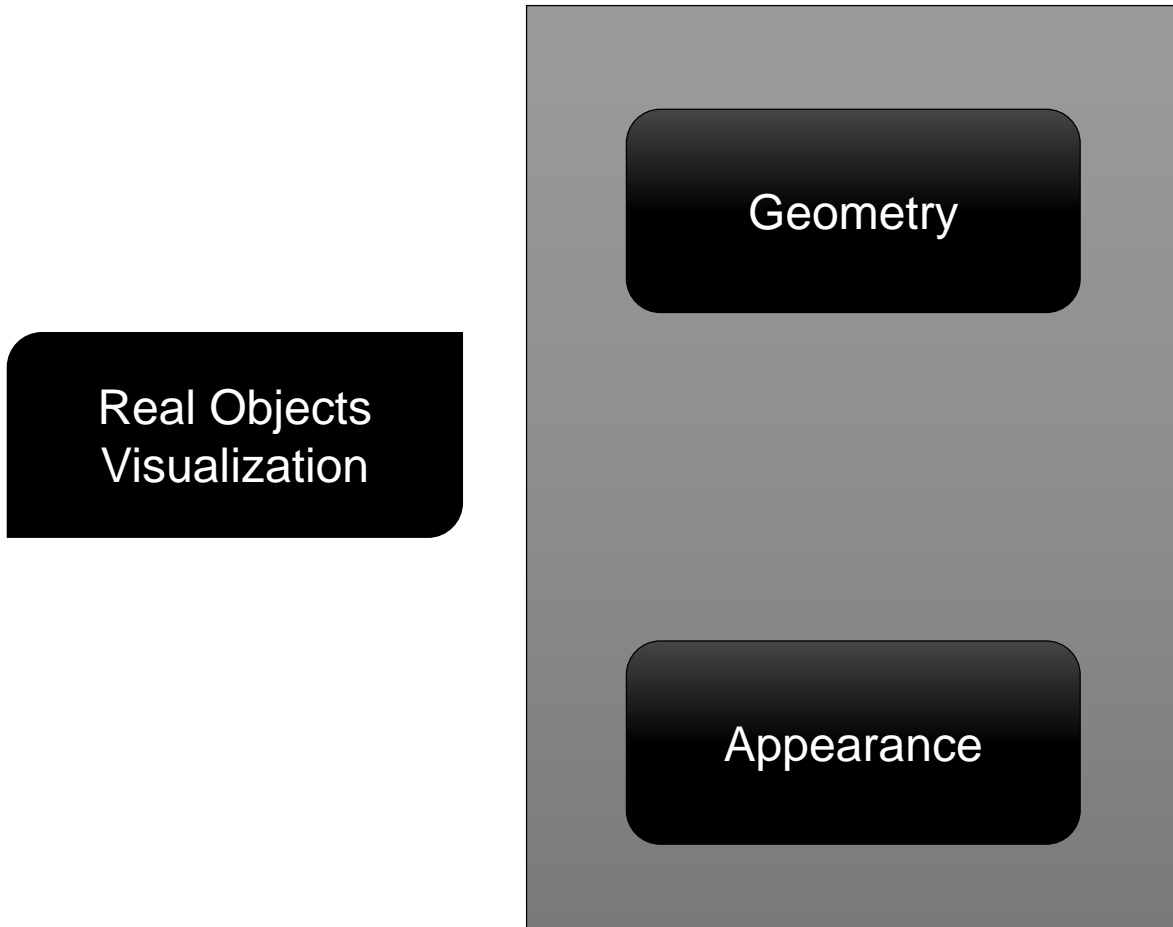
¹University of California, San Diego

²Adobe Research

UC San Diego
Computer Science and Engineering
JACOBS SCHOOL OF ENGINEERING



Objects Visualization



Objects Visualization

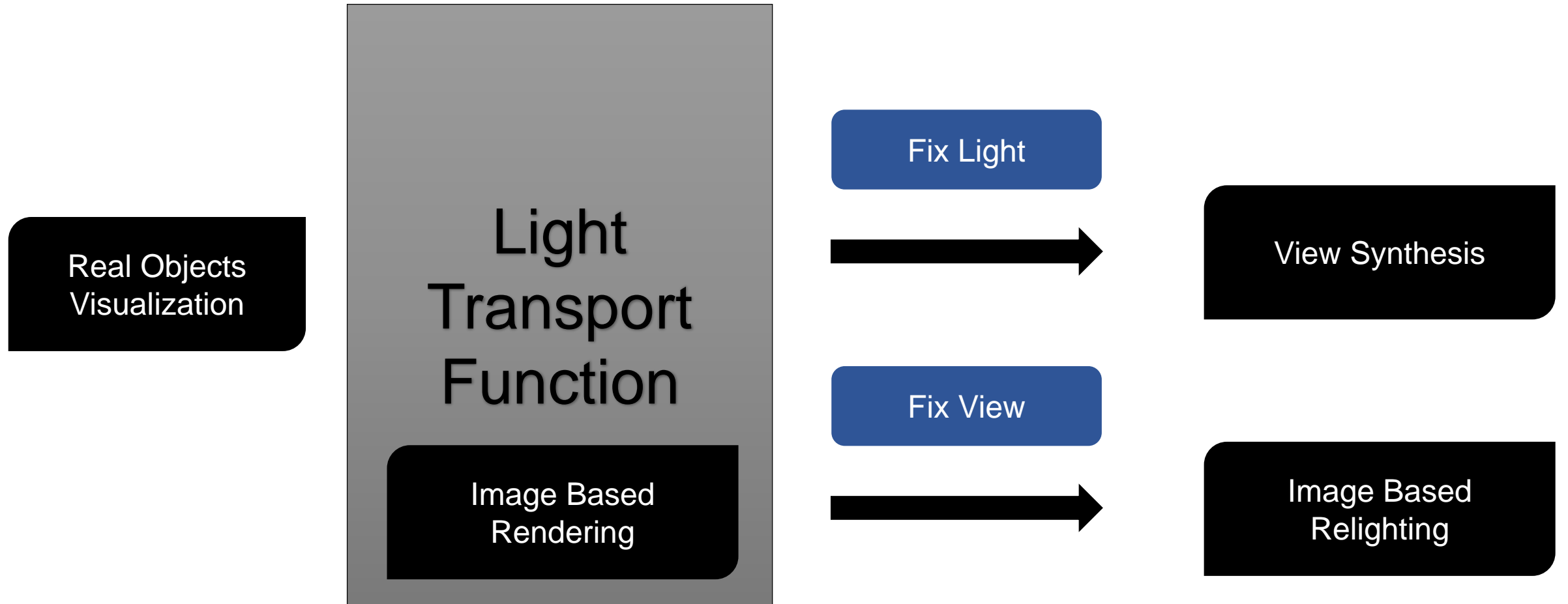


Image Based Relighting

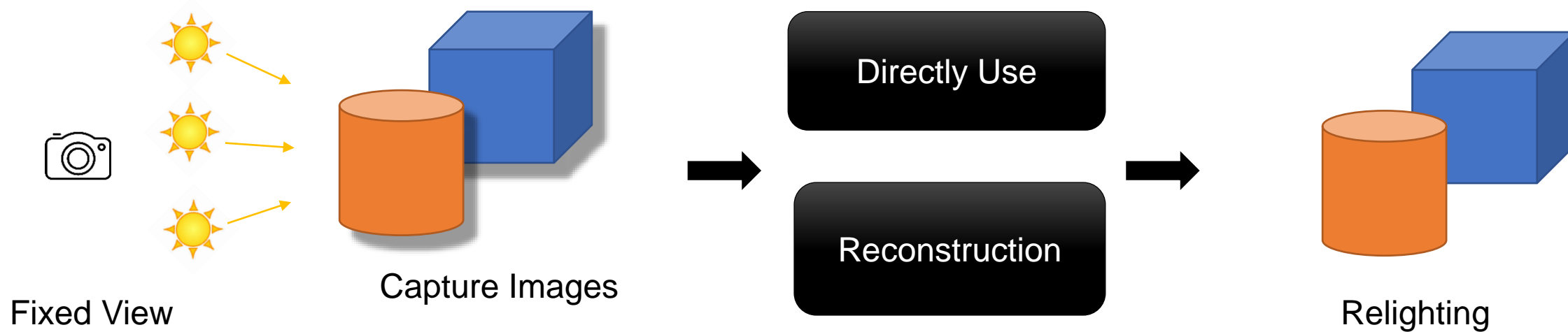
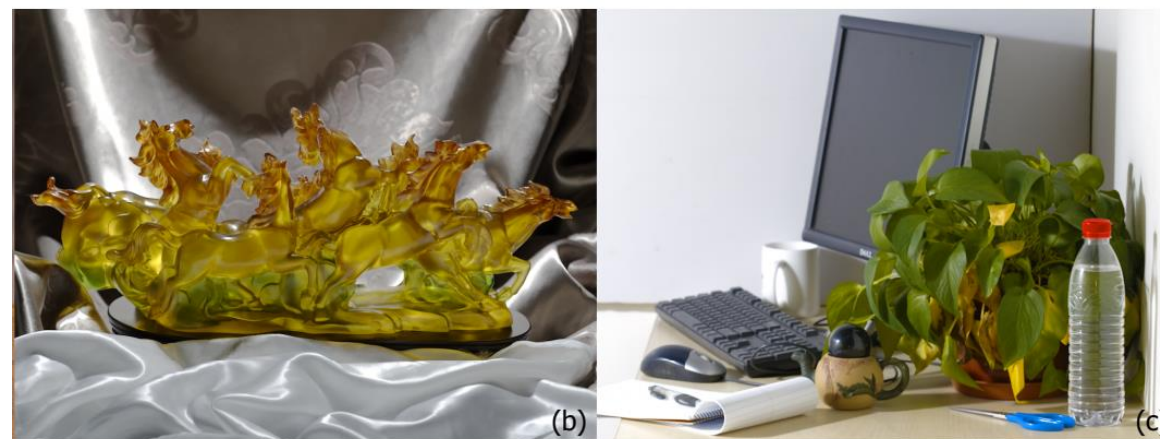
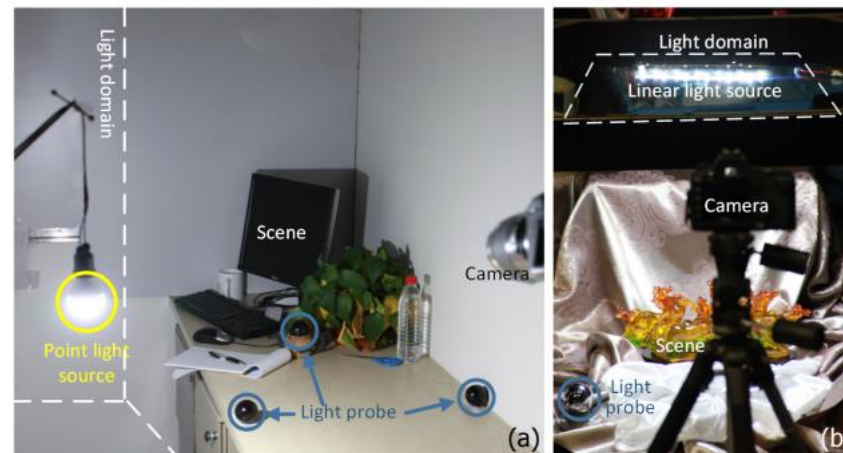


Image Based Relighting



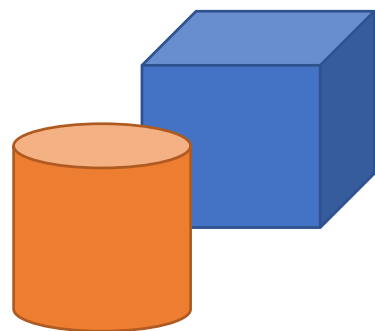
[Debevec et al. 2000] 2000+ Images



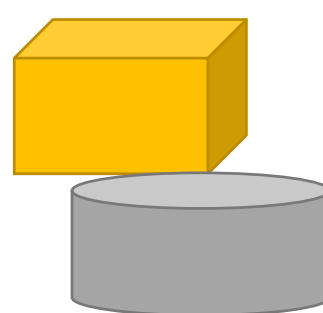
[Ren et al. 2015] 200+ Images

Image Based Relighting

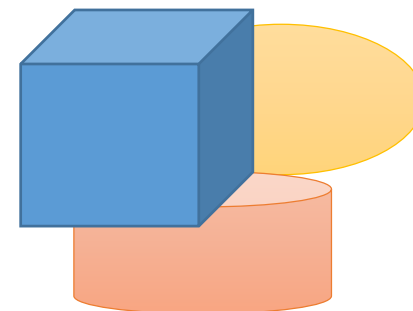
Previous methods:



Target Scene



Others Scenes



...

Hundreds images

Explore data coherence only for target scene

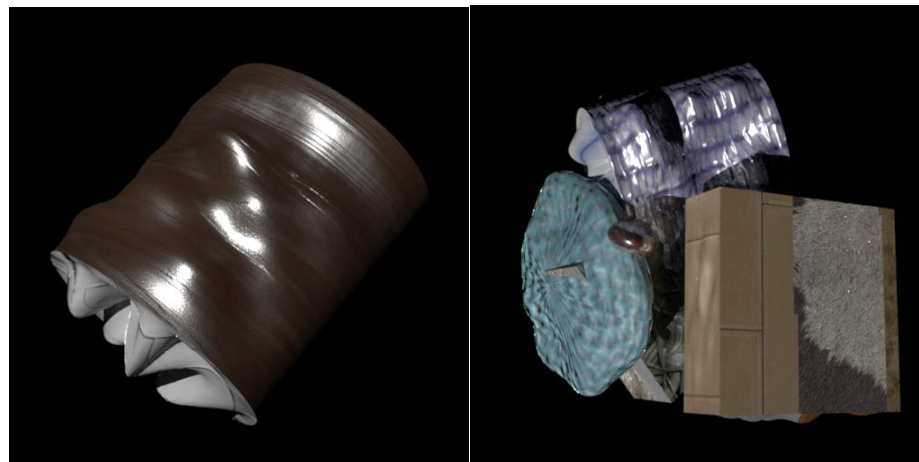
Hard to acquire
data

Preview

Our method:

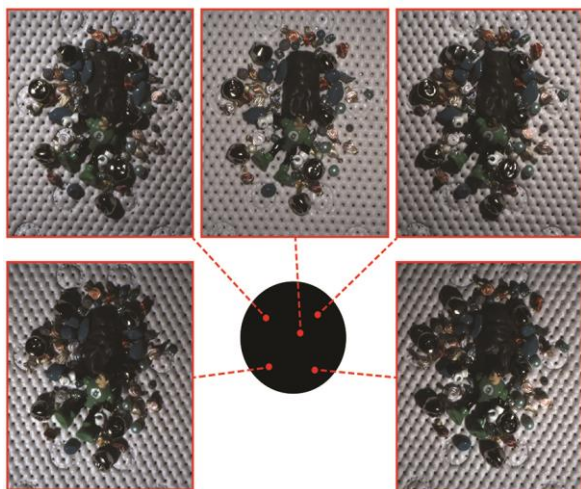


Real Target Scene



Known Synthetic Scenes

...



Capture

CNN



Relight

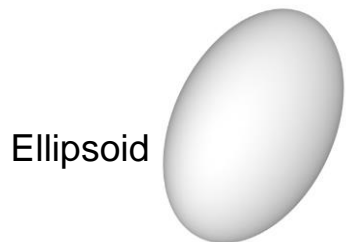
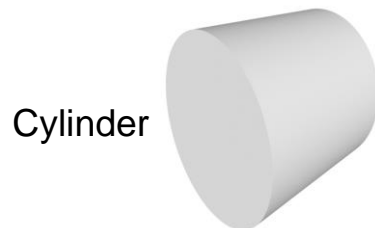
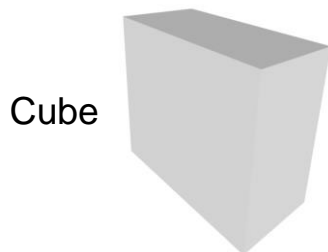
Sparse Relighting Samples (5 images)

CNN

Images under Other Lighting

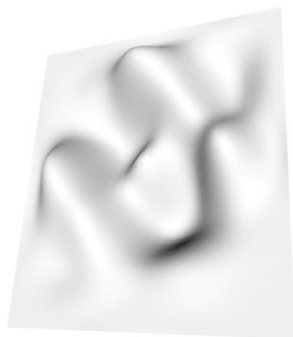
Synthetic Scenes

Procedurally
Generated
Objects

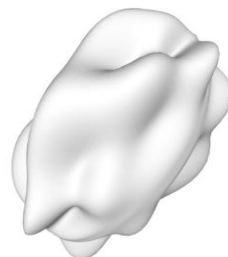
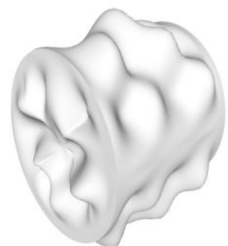
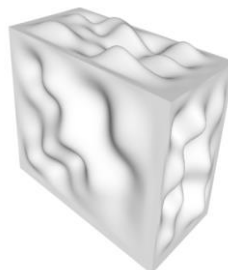


Random
Size

+



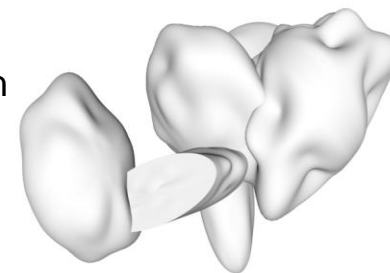
Random Height
Field



Random
Translation



Random
Rotation



Texture:
Adobe Stock
Material
Dataset

Synthetic Scenes

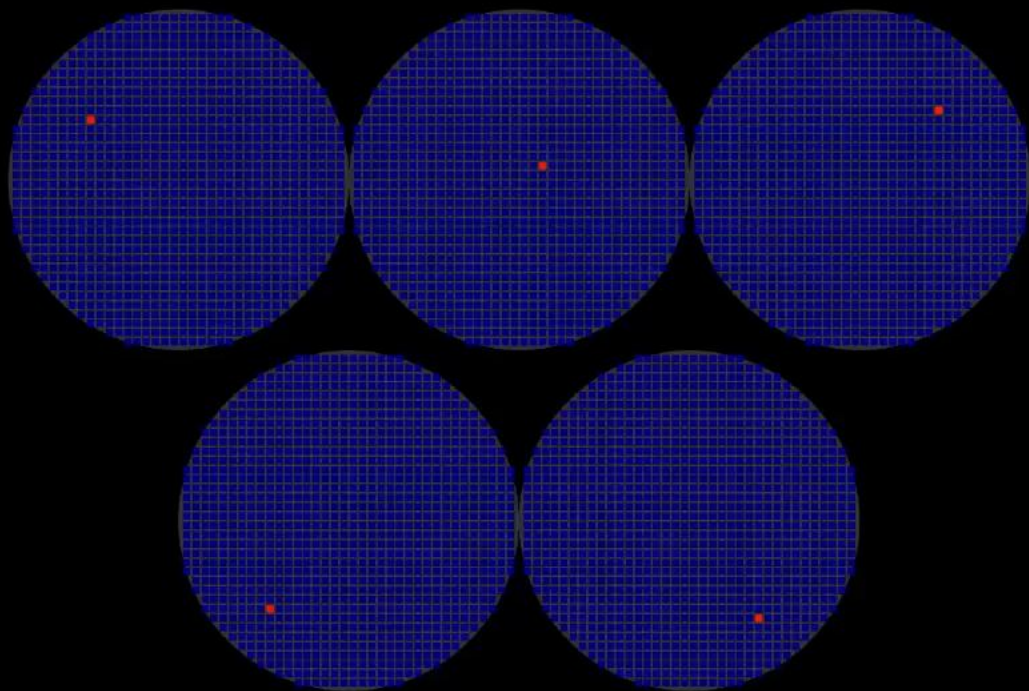
Procedurally
Generated
Objects



Texture:
Adobe Stock
Material
Dataset

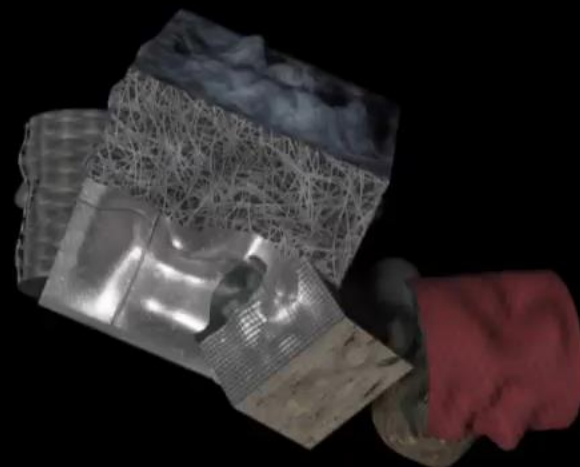
Preview

Sample-Net:
learn optimal light directions

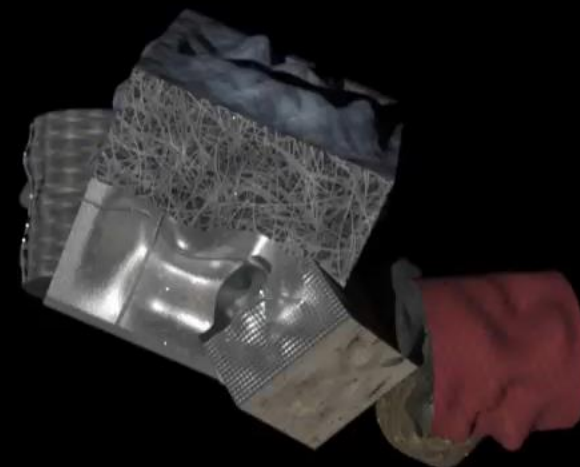


Relight-Net:
learn the relighting function

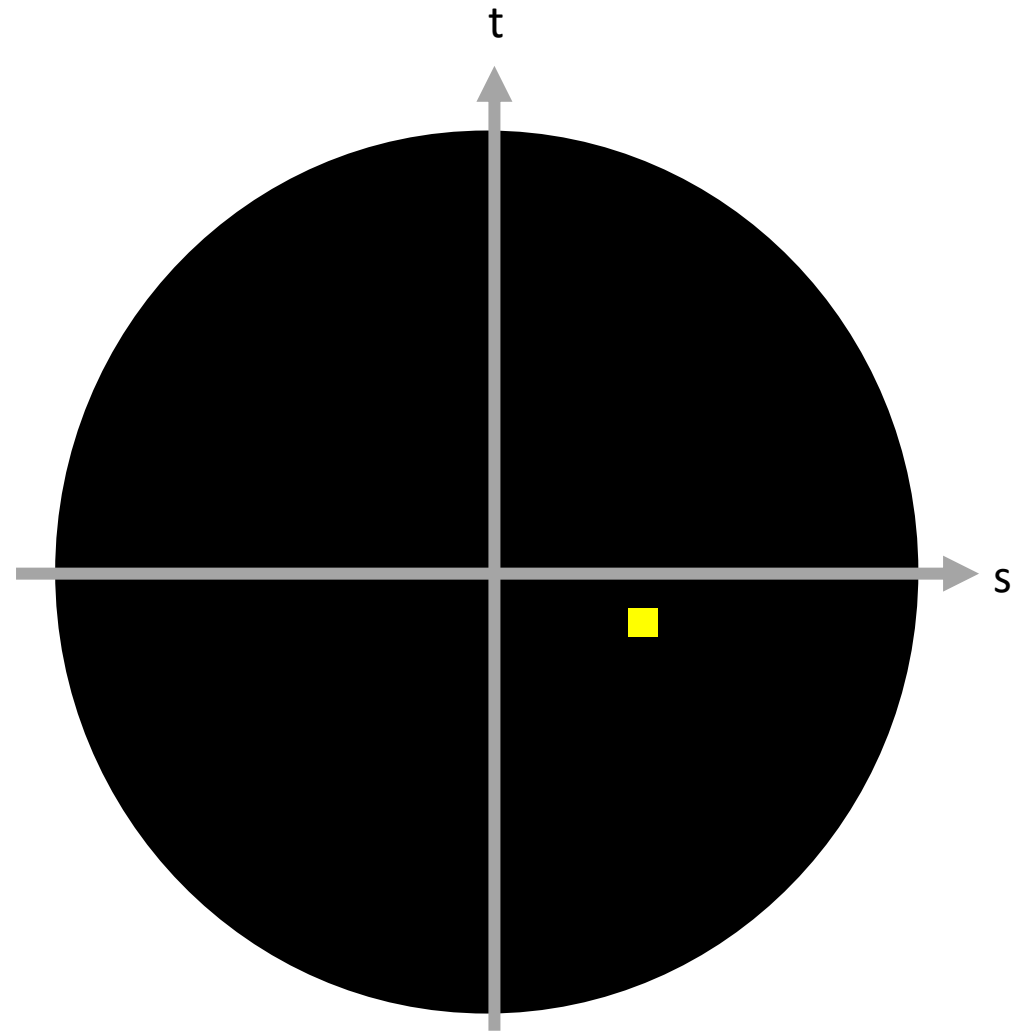
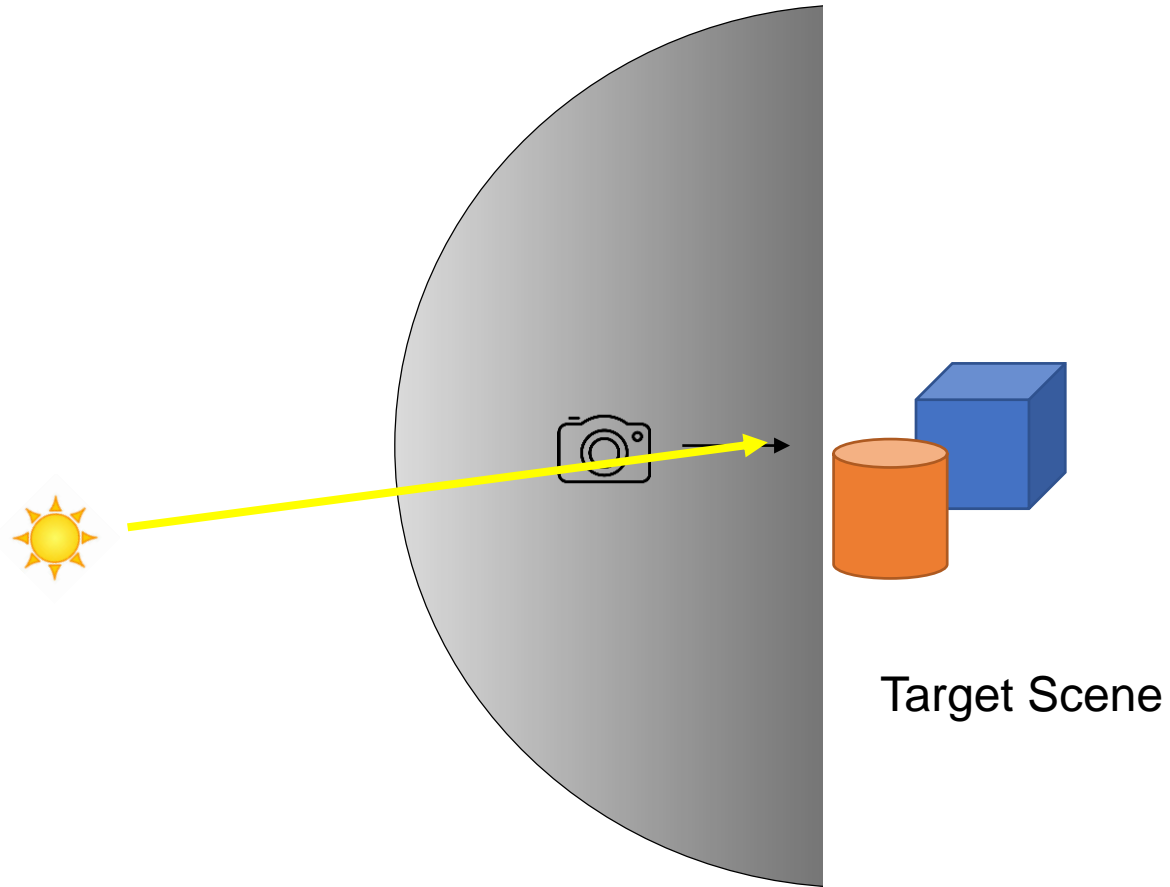
Our result



Ground truth

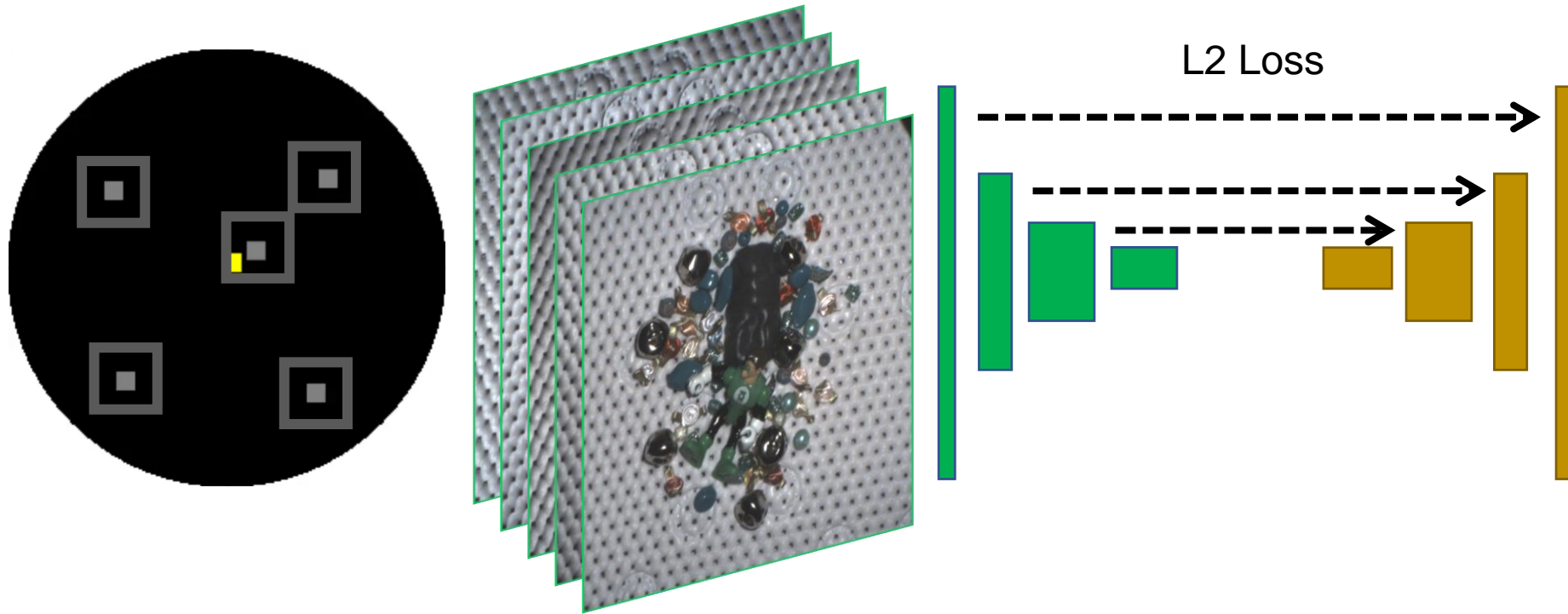


Light Configuration

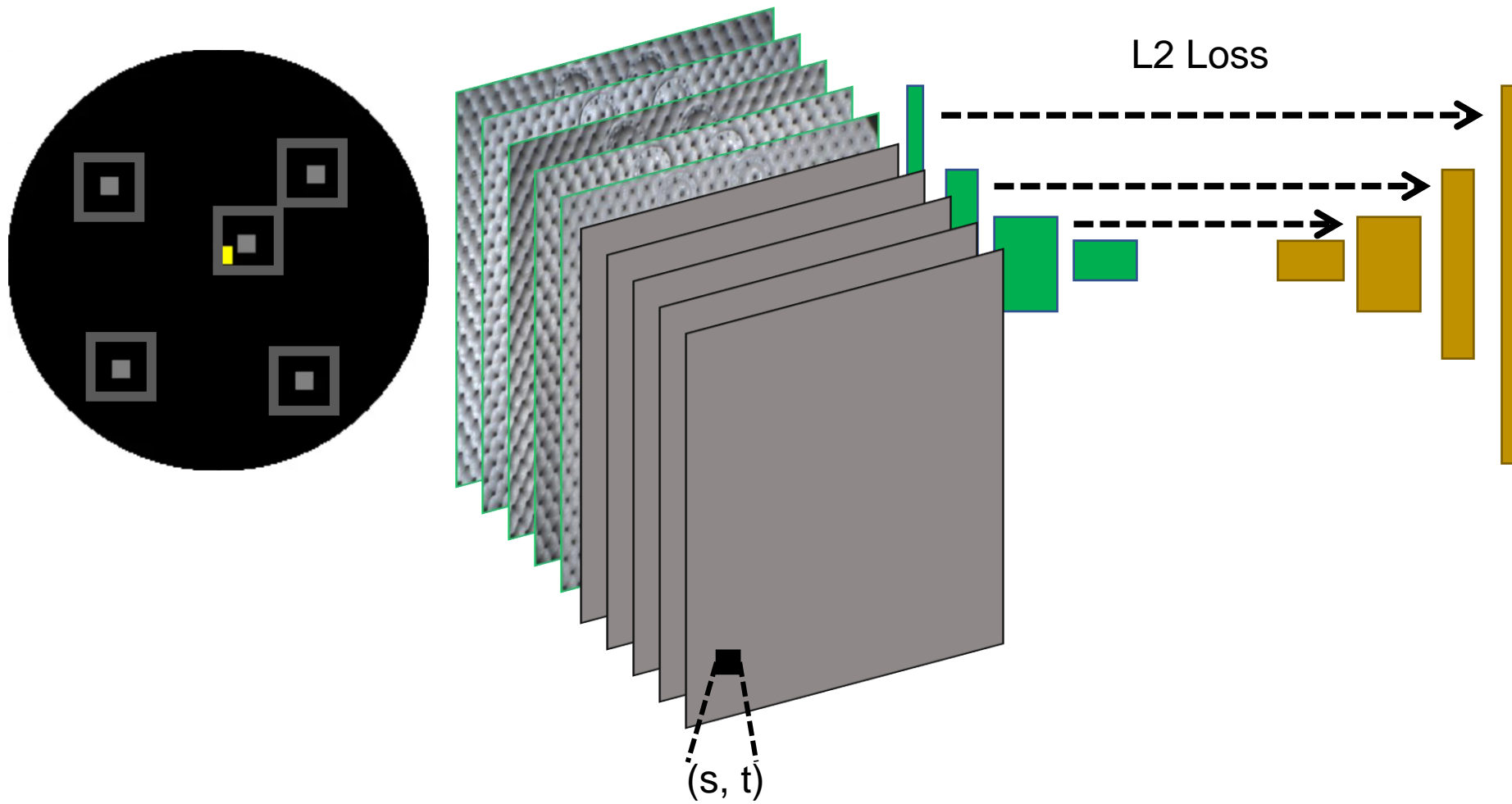


s, t Coordinates

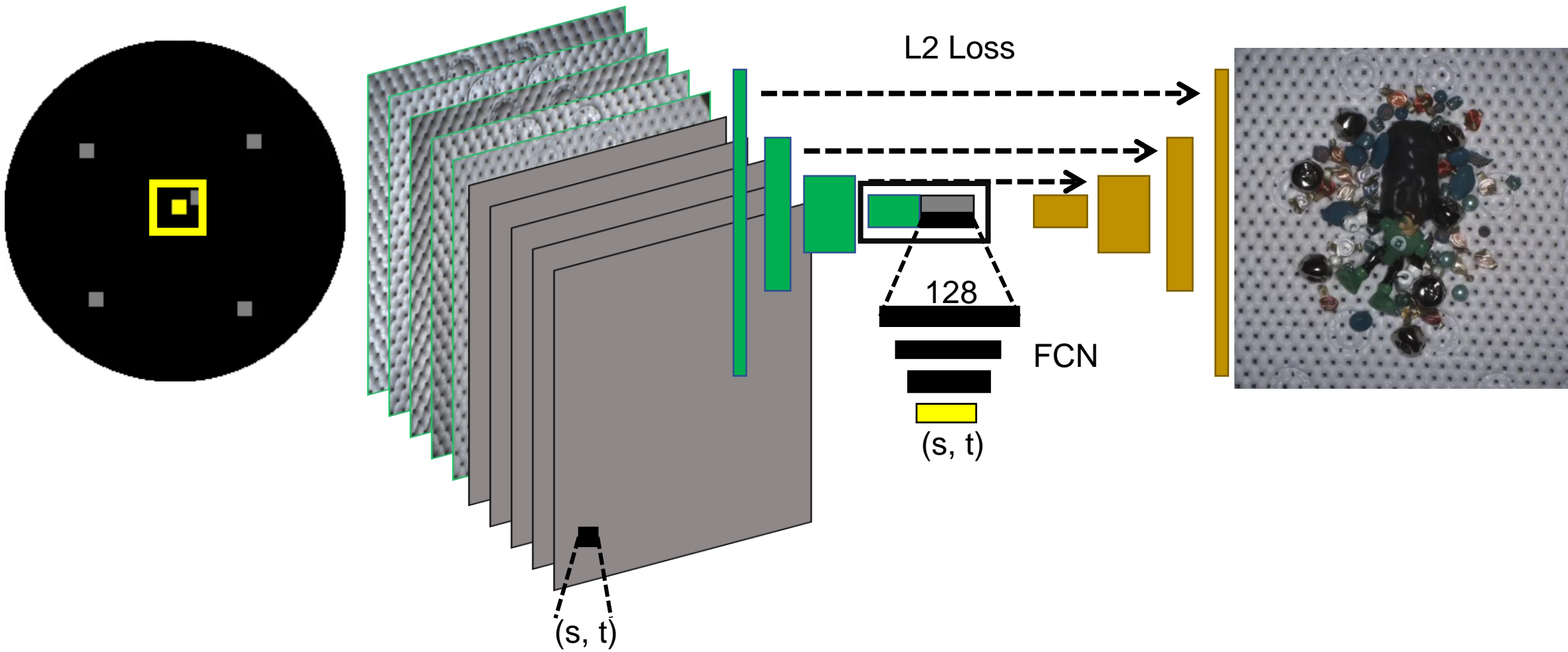
Relight Net



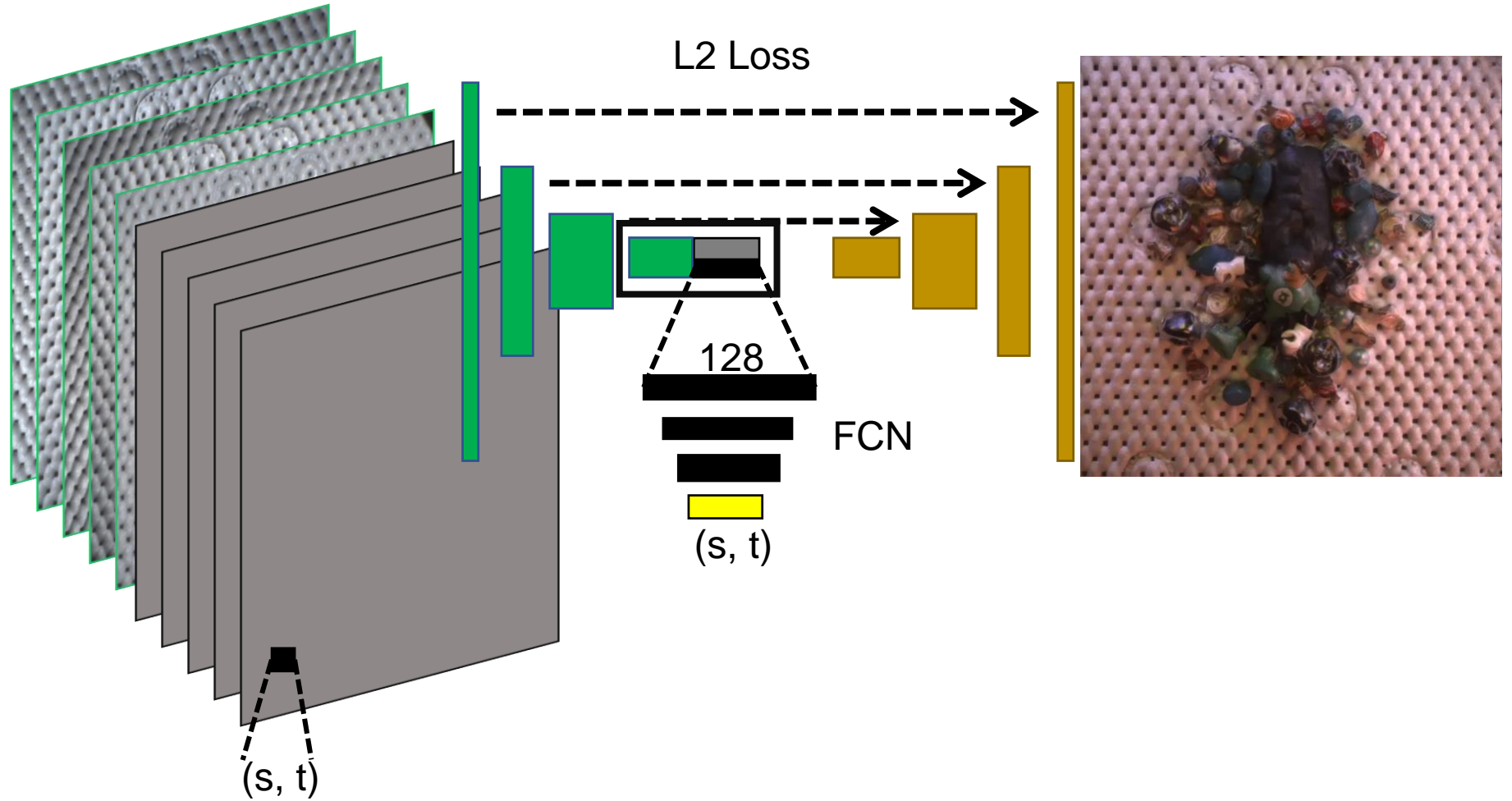
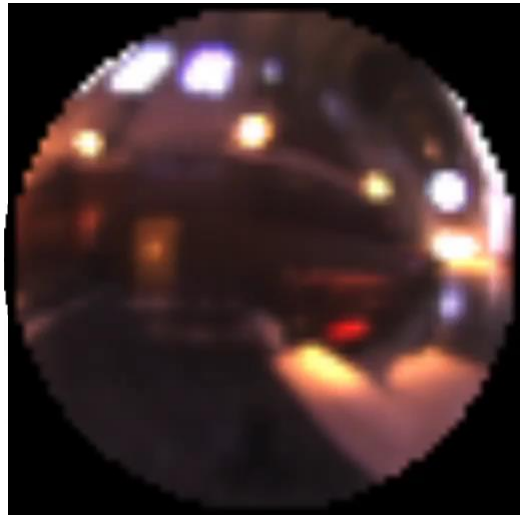
Relight Net



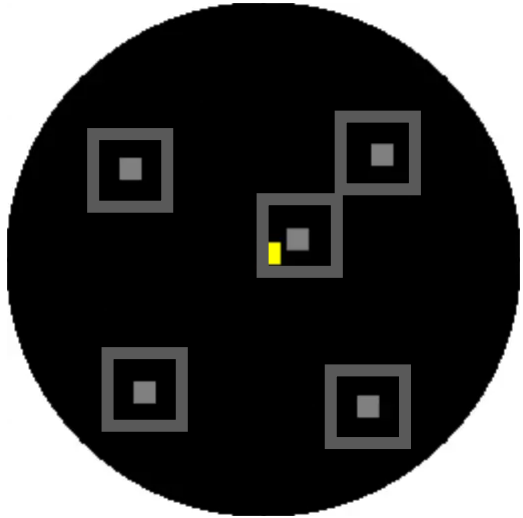
Relight Net



Relight Net

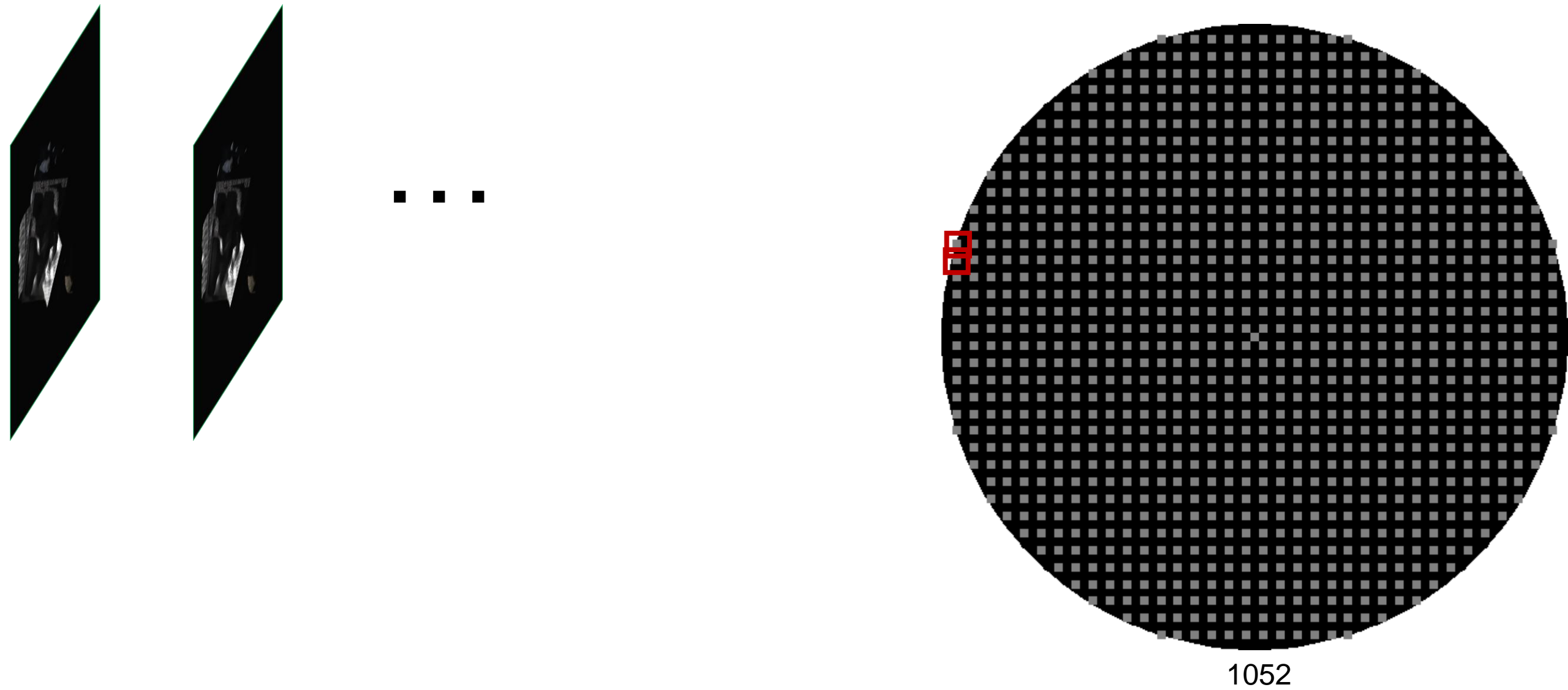


Sampling Directions



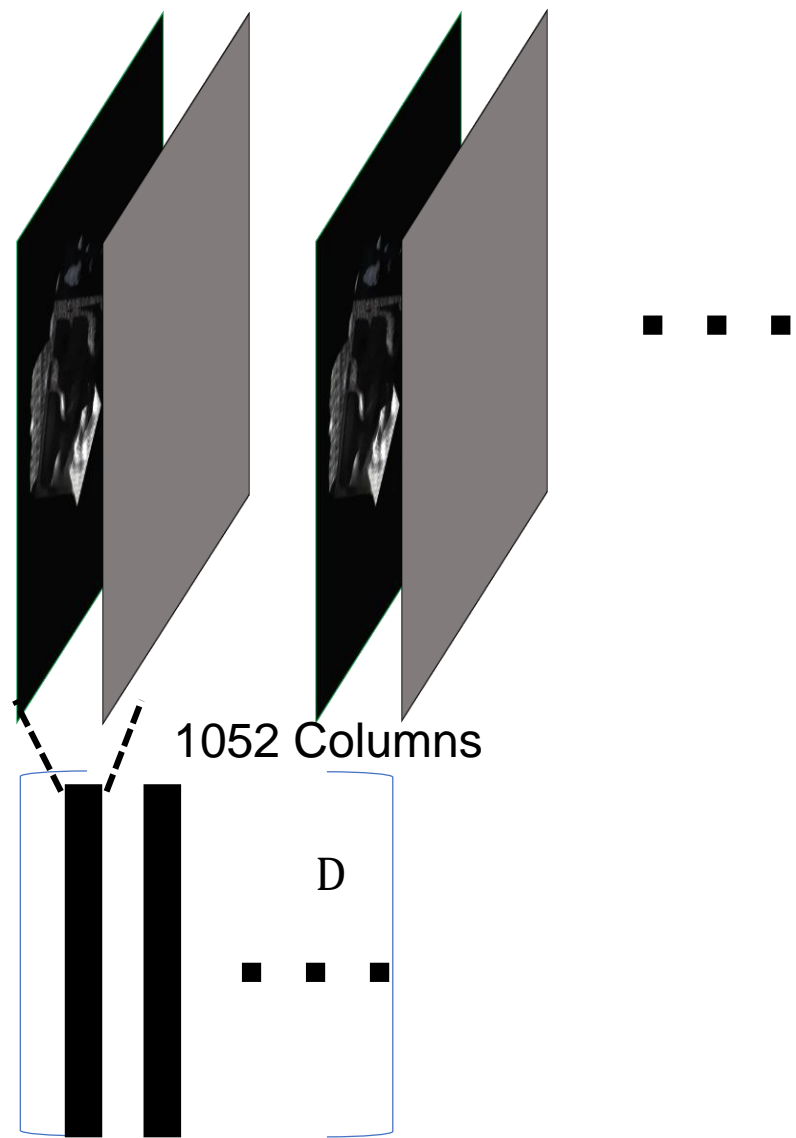
- How to choose input directions.
- Minimize relighting error.
 - deep learning training process
- Embed light into network.
 - Select samples from a group of candidates

Sample Net



Sample Net

1052 pairs



1052 Columns

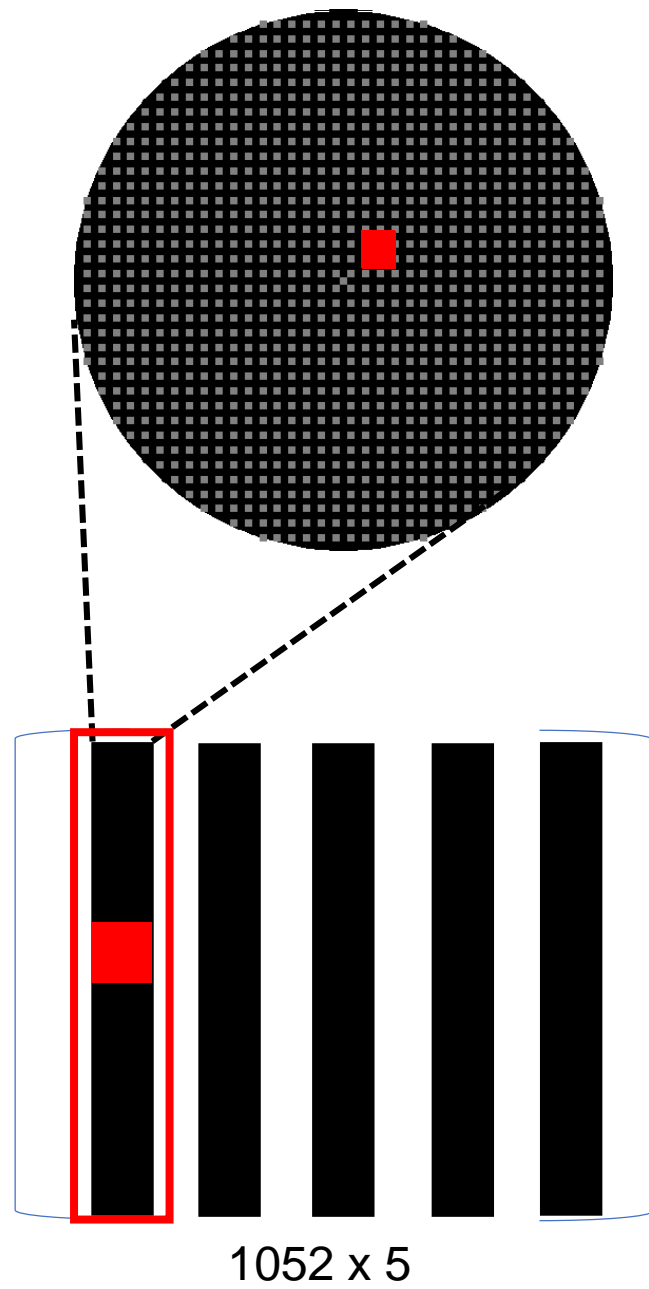
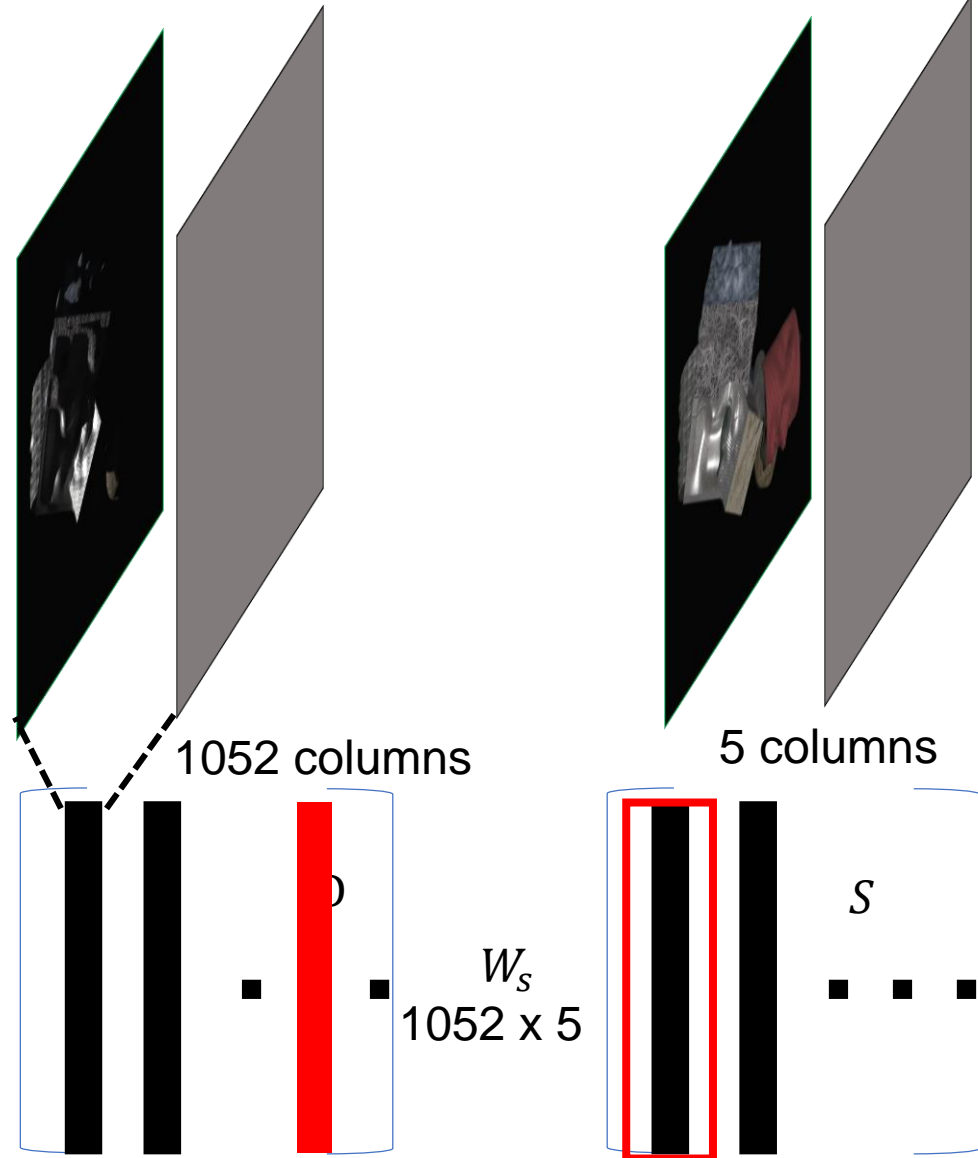
D

...

Sample Net

1052 pairs

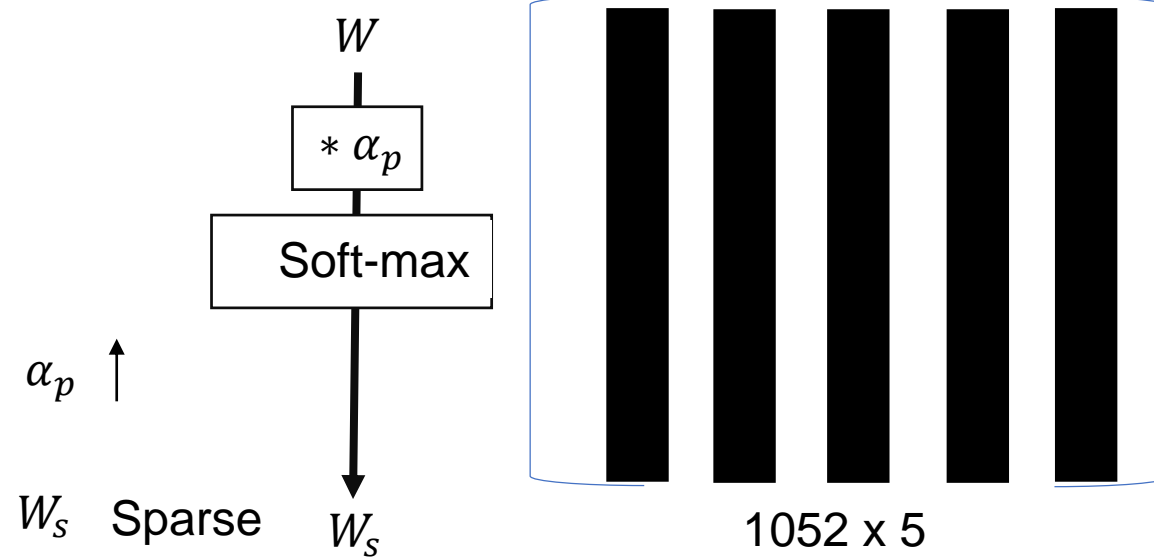
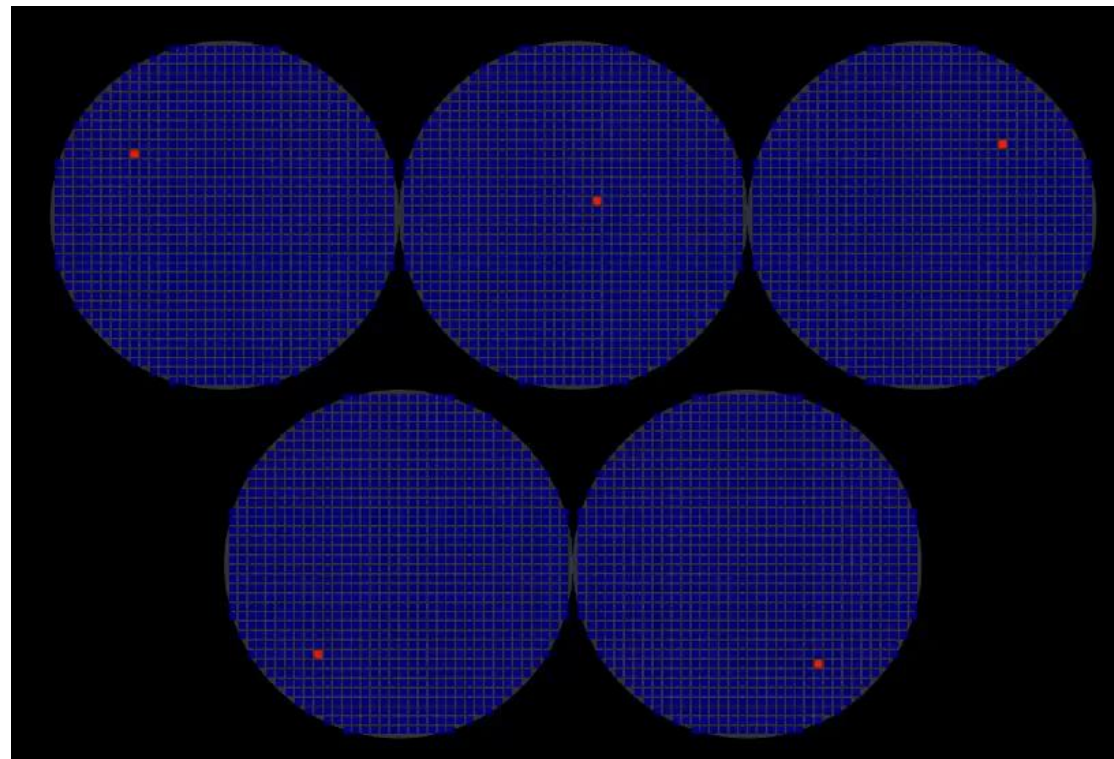
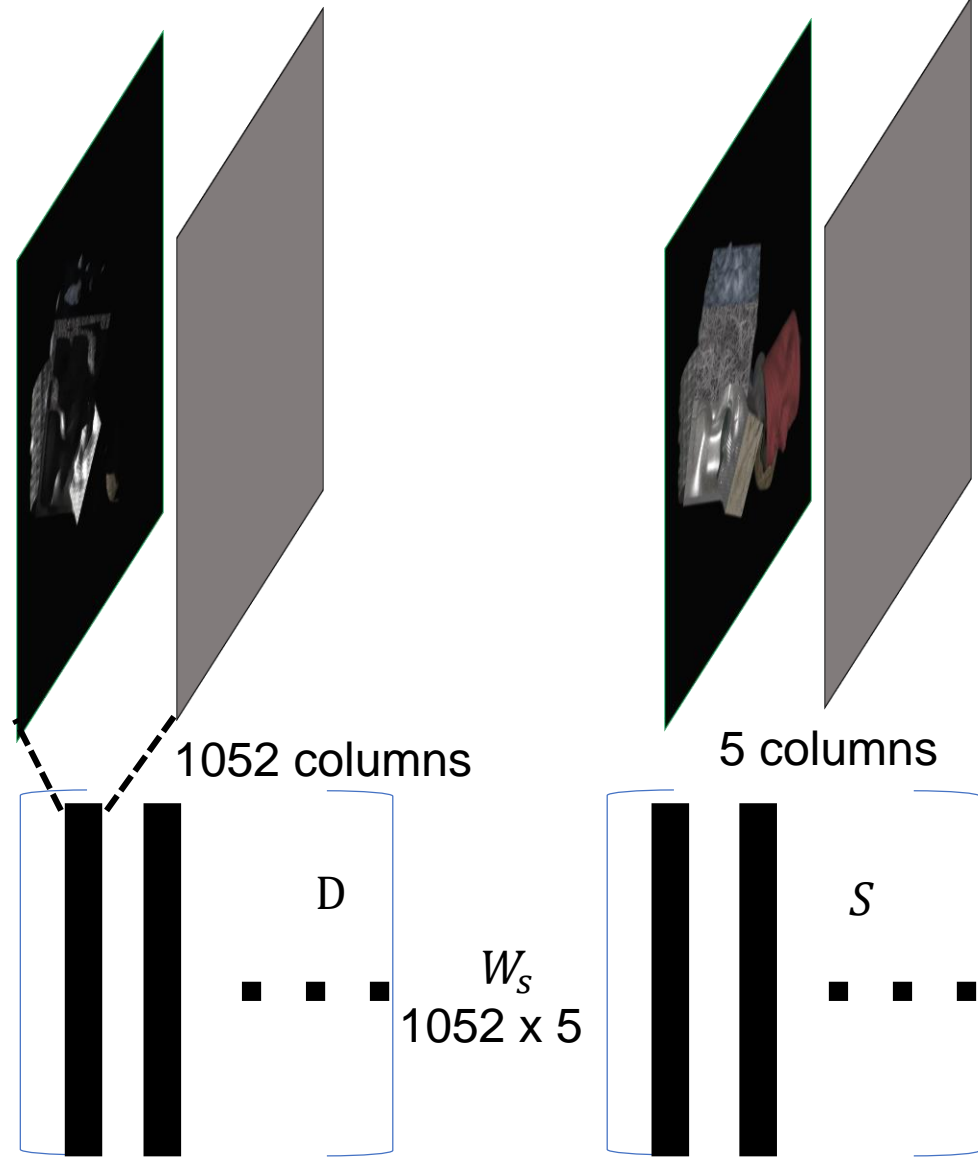
5 pairs



Sample Net

1052 pairs

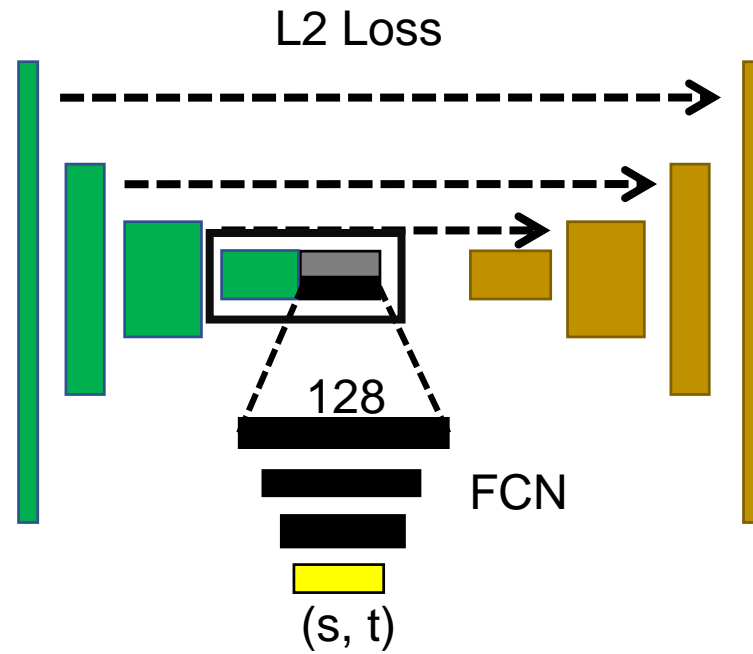
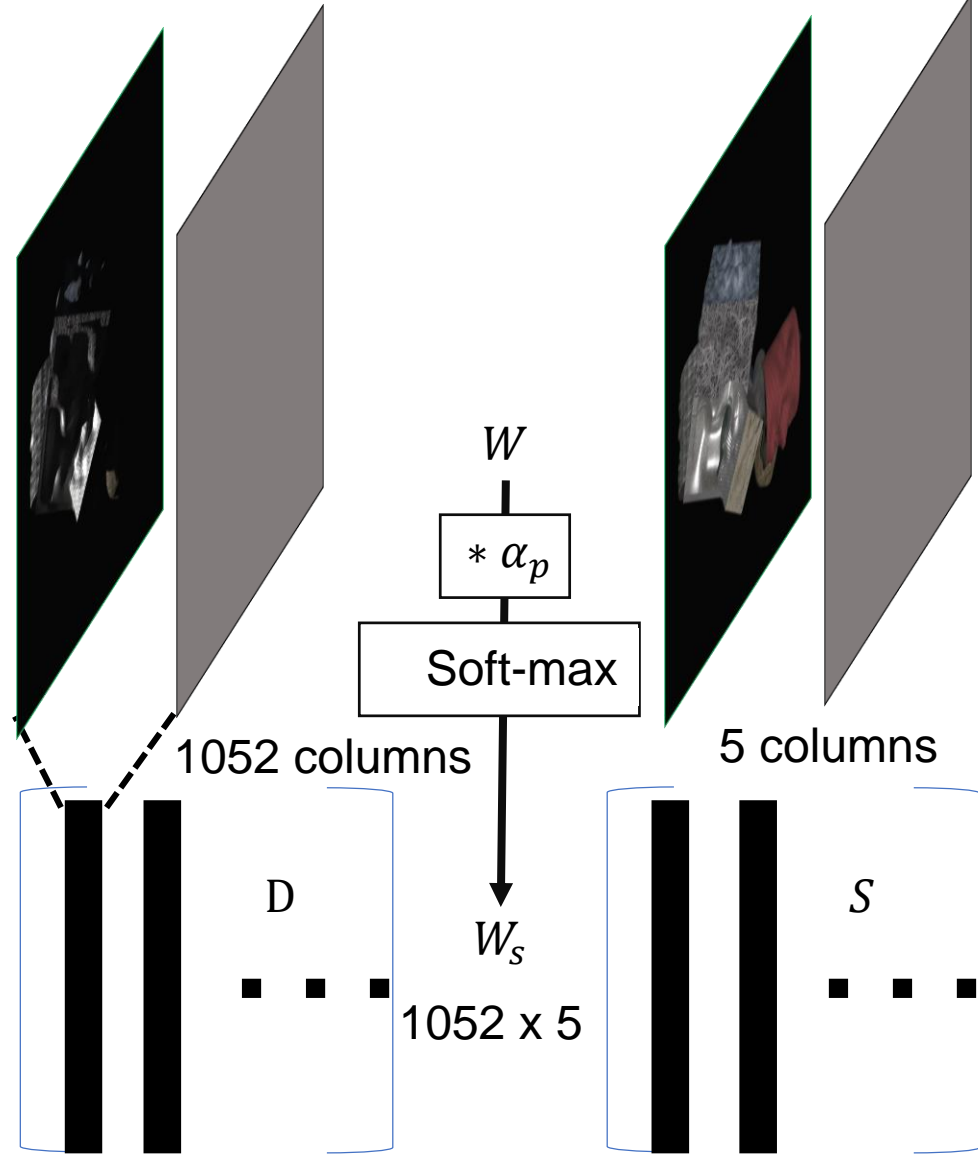
5 pairs



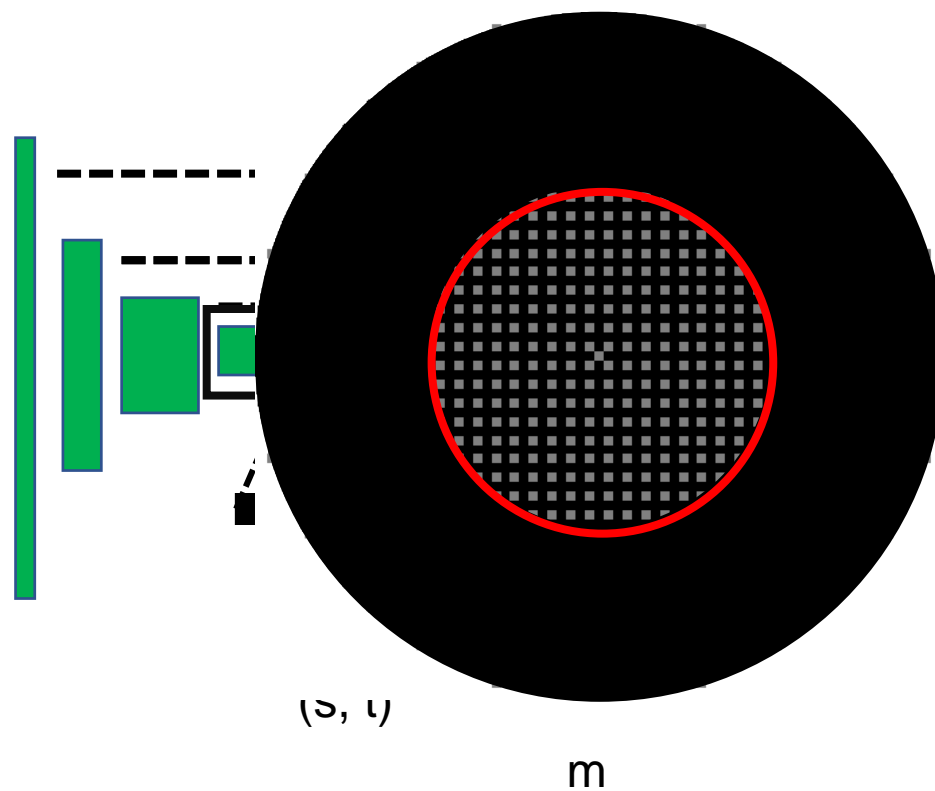
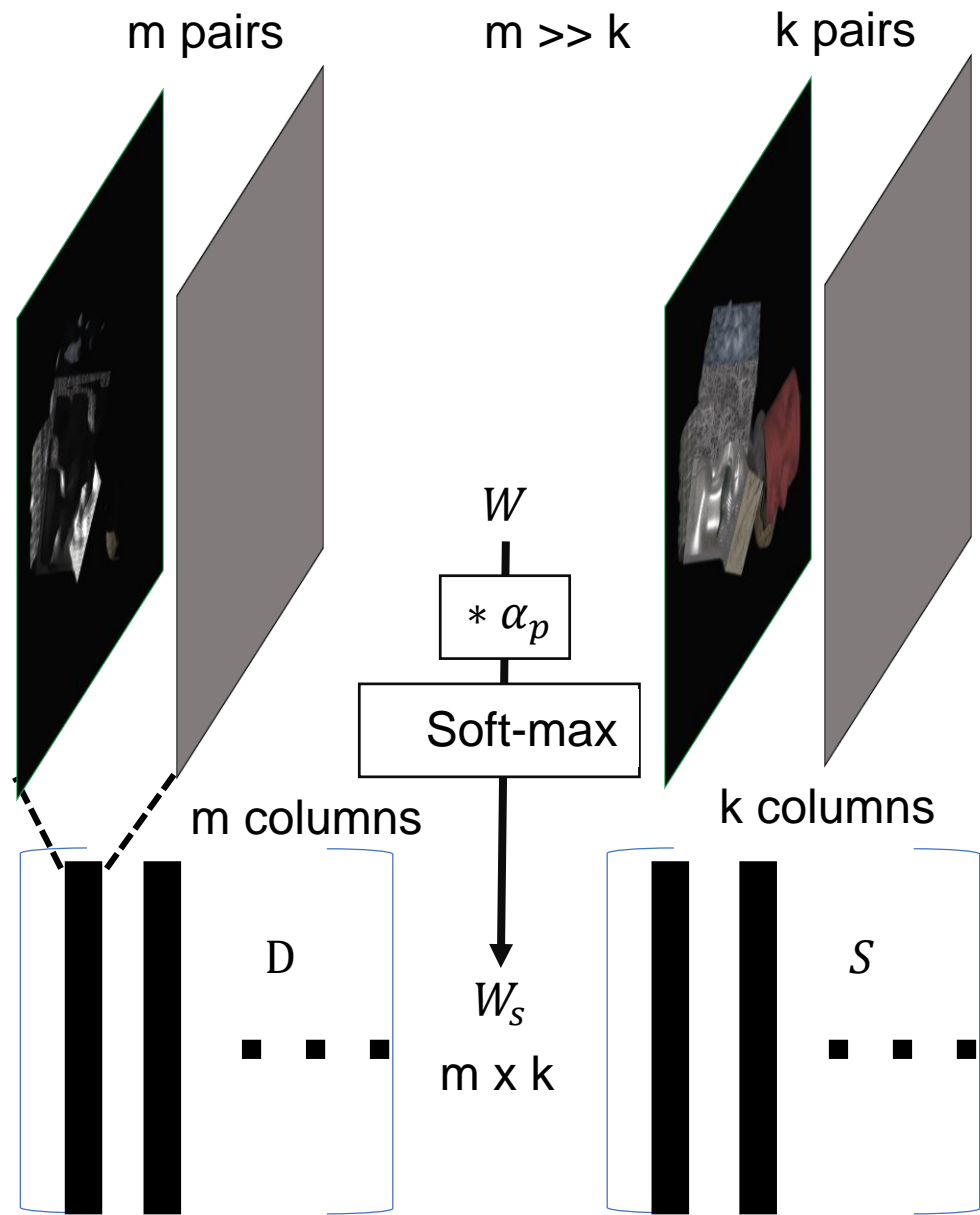
Sample Net + Relight Net

1052 pairs

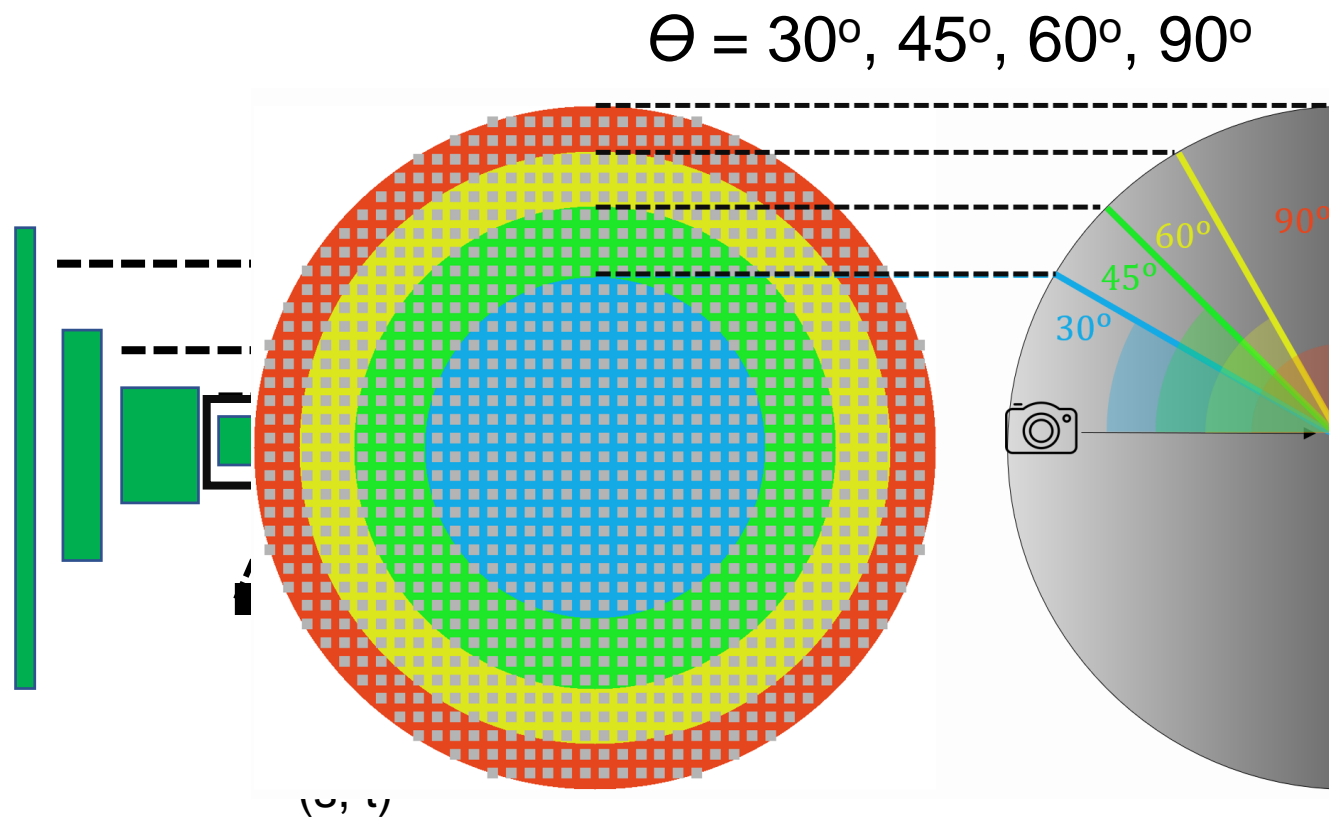
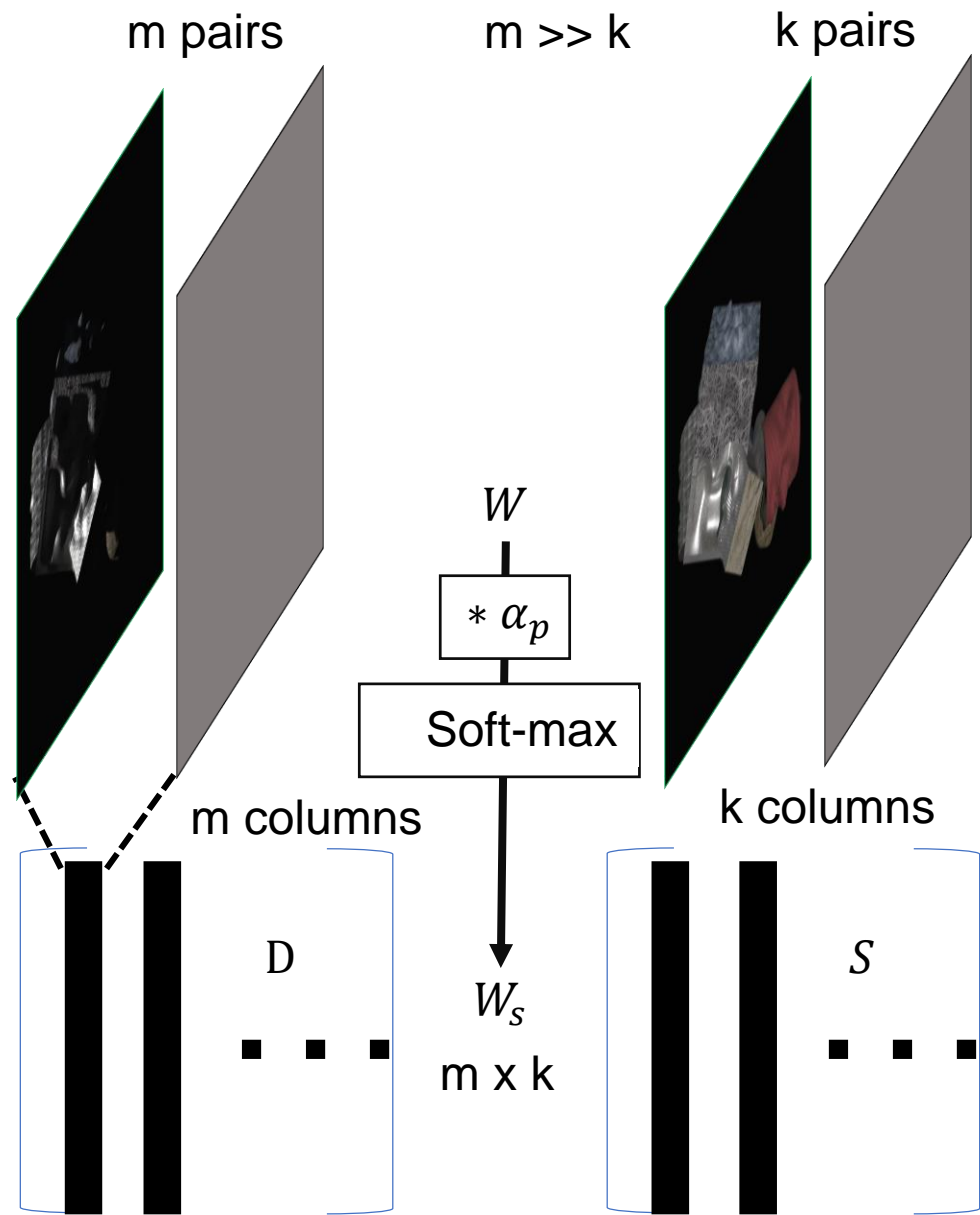
5 pairs



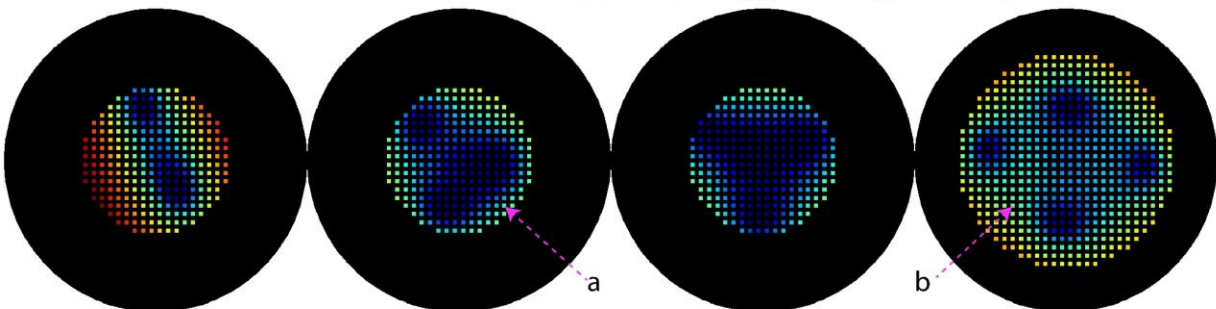
Sample Net + Relight Net



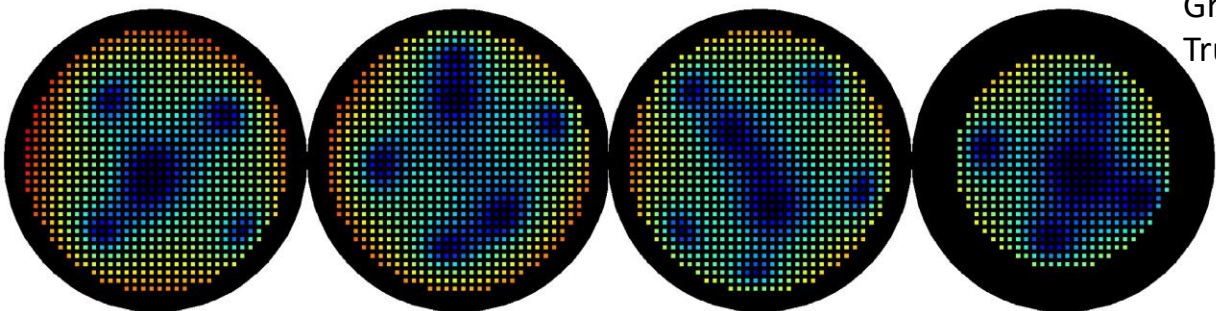
Sample Net + Relight Net



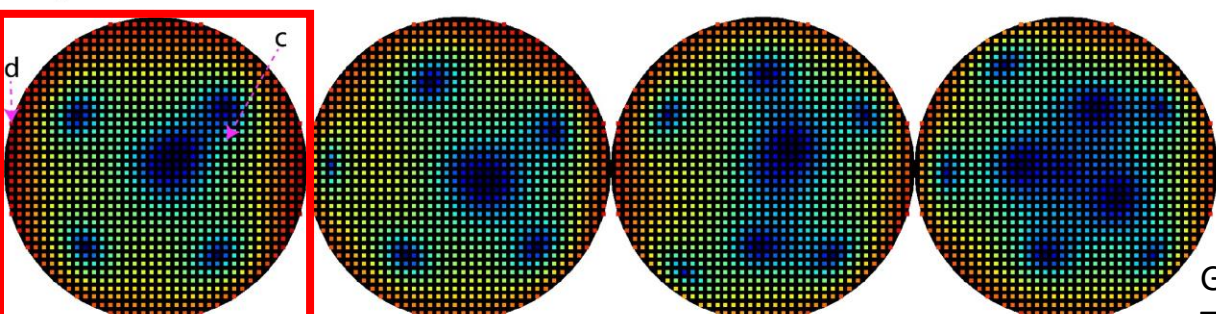
PSNR Distributions with Different Training Setting



$\theta = 30, k = 2$ Average PSNRs: 23.63
 $\theta = 30, k = 3$ 27.15
 $\theta = 30, k = 4$ 28.16
 $\theta = 45, k = 4$ 25.20



$\theta = 60, k = 5$ Average PSNRs: 24.22
 $\theta = 60, k = 6$ 24.84
 $\theta = 60, k = 7$ 25.09
 $\theta = 45, k = 5$ 26.01



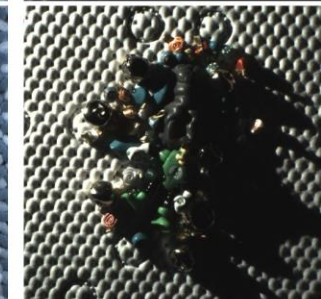
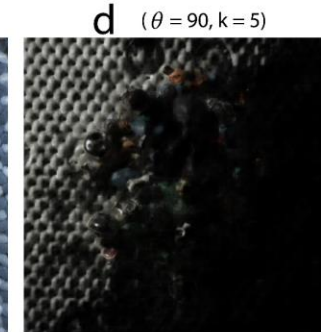
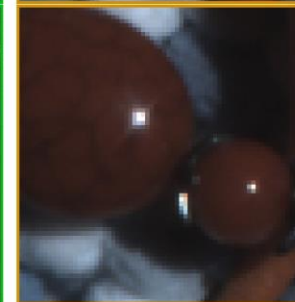
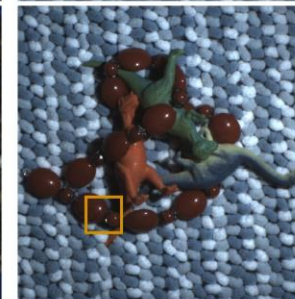
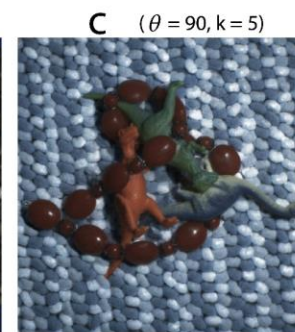
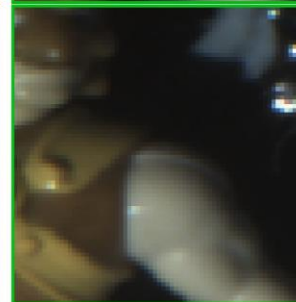
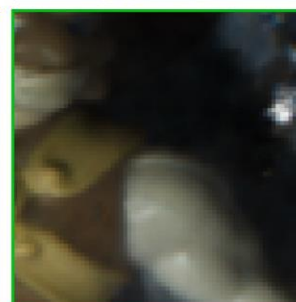
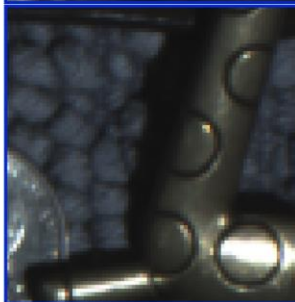
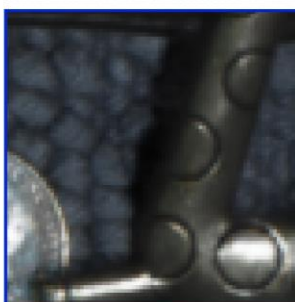
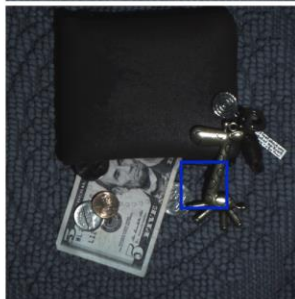
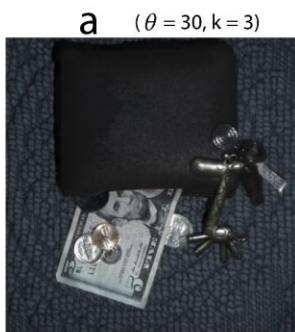
$\theta = 90, k = 5$ Average PSNRs: 23.12
 $\theta = 90, k = 6$ 23.55
 $\theta = 90, k = 7$ 23.93
 $\theta = 90, k = 8$ 24.46

Our Result

Ground Truth

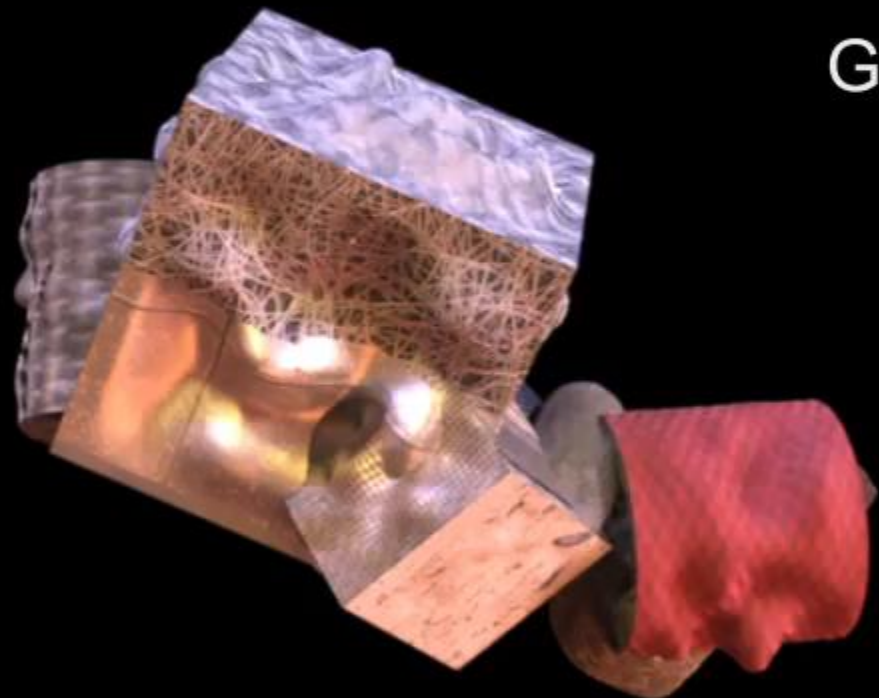
Our Result

Ground Truth

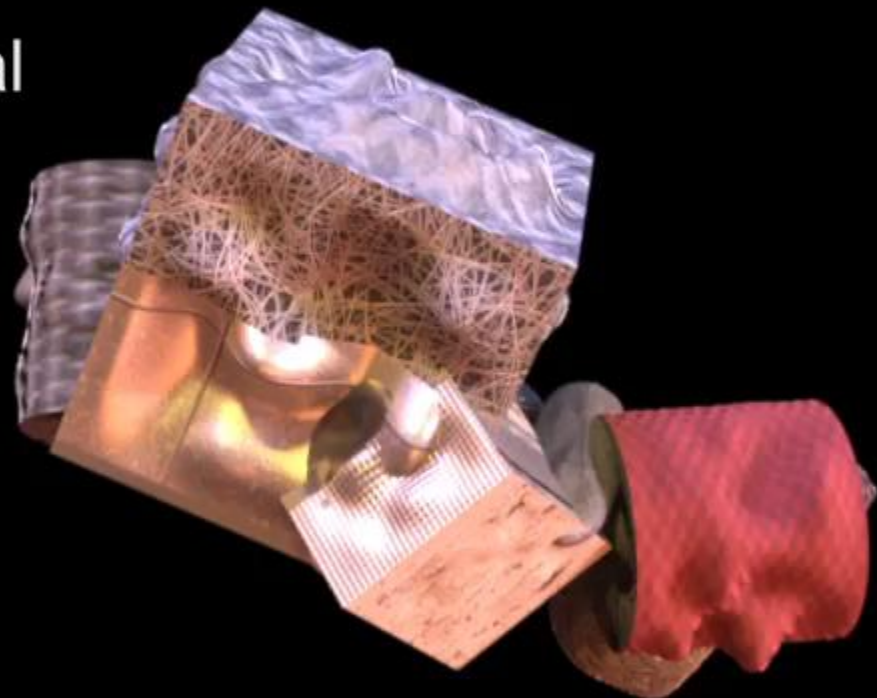


Environment Map Rendering Results

Grace Cathedral

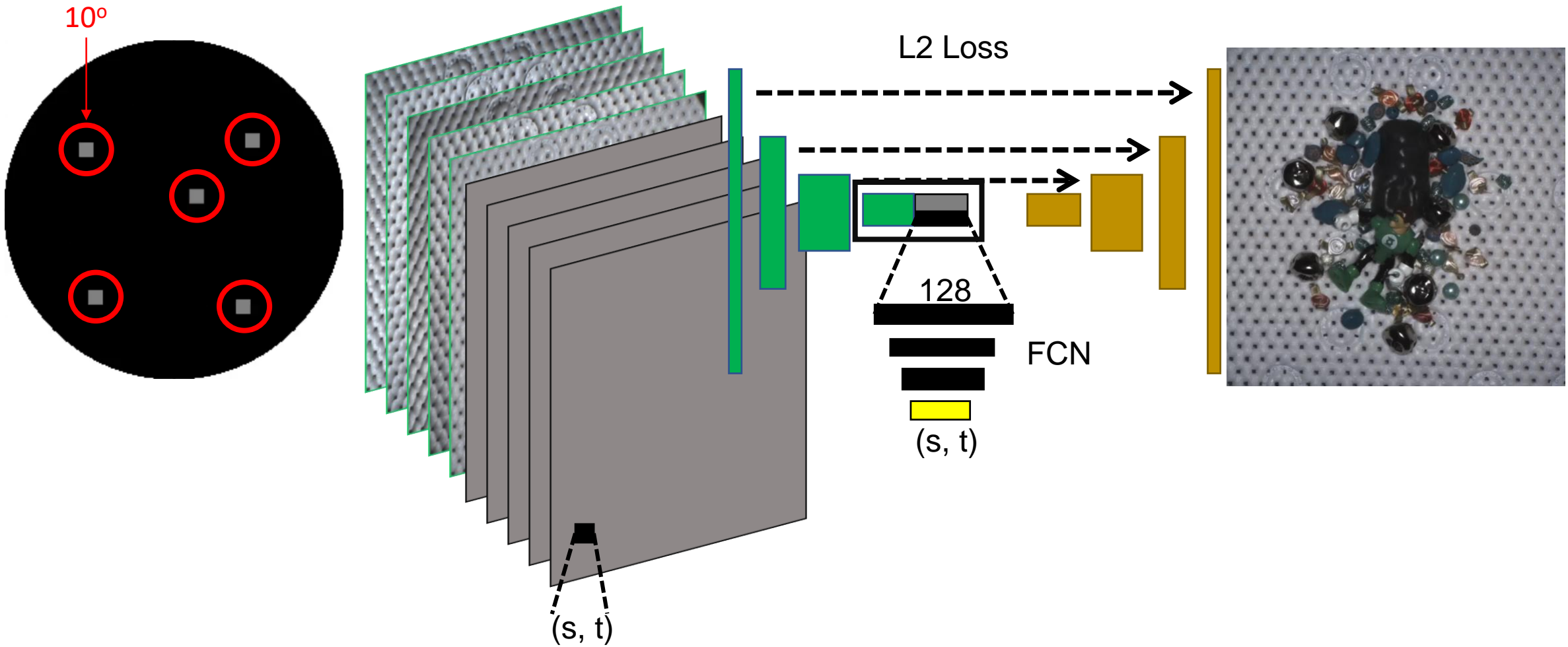


our result



ground truth

Refine Relight Net



Our Real Data #2 Environment Map (Frontal Hemisphere) Rendering

Galileo's Tomb



Grace Cathedral



Future Work

- Do reconstruction.
 - Geometry + BRDF
- Sparse sampling in general image based rendering.
 - Relight + View Synthesis
- Sparse sampling in rendering.
 - Precomputed Radiance Transfer (PRT)

Thank You!

Project Page: <http://viscomp.ucsd.edu/projects/SIG18Relighting>

My Website: <http://cseweb.ucsd.edu/~zex014/>

My Email: zexiangxu@cs.ucsd.edu