SIGGRAPH ASIA 2020 VIRTUAL

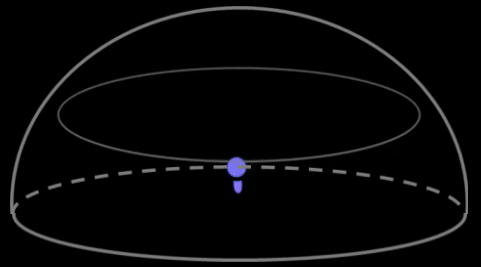
Deferred Neural Lighting: Free-viewpoint Relighting from Unstructured Photographs

Duan Gao, Guojun Chen, Yue Dong, Pieter Peers, Kun Xu, Xin Tong

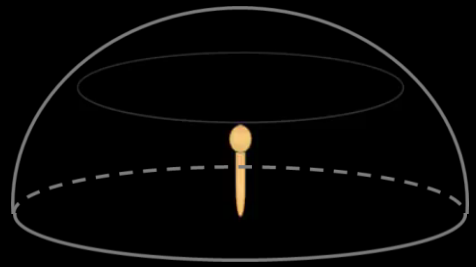
3D object digitization

Real-world scene

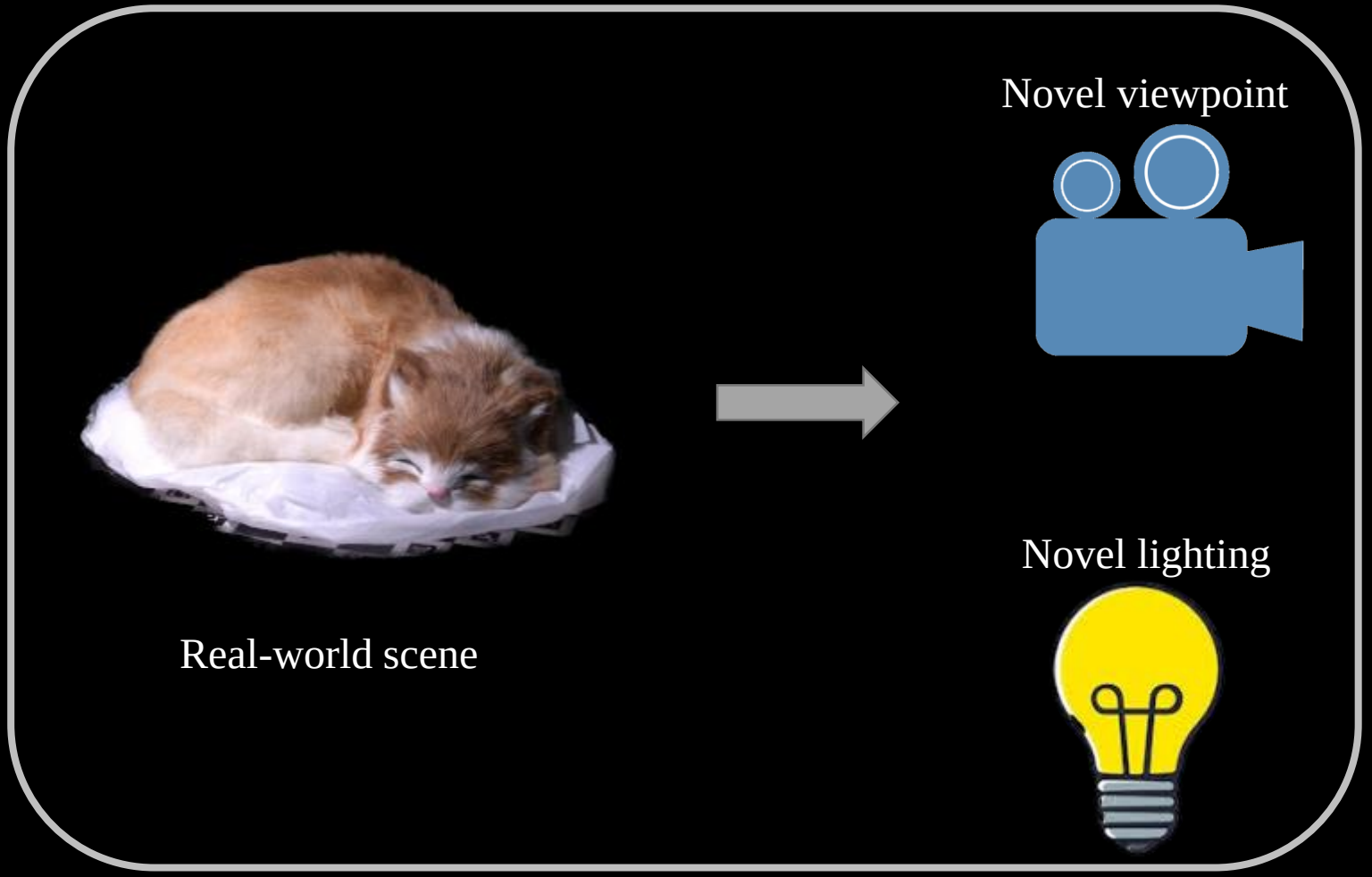
Novel viewpoint



Novel lighting

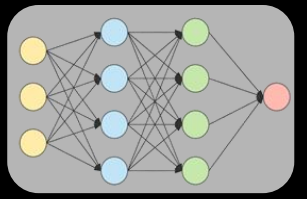


3D object digitization



VR/AR content creation

Training data generation



Virtual shopping

Related work

Model-based methods

- Reconstruct the geometry and appearance explicitly.
- Support re-rendering naturally
- Inaccuracy due to practical and model limitations

Nam et al. 2018

Kang et al. 2019

Related work

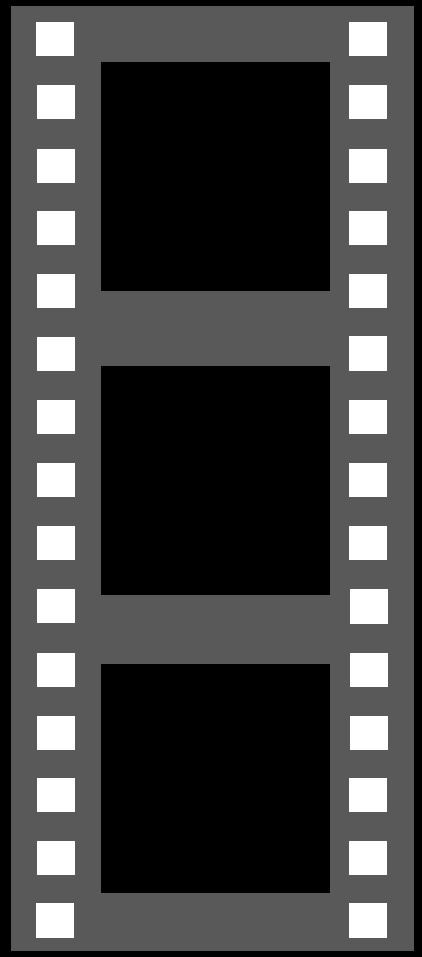
Image-based methods

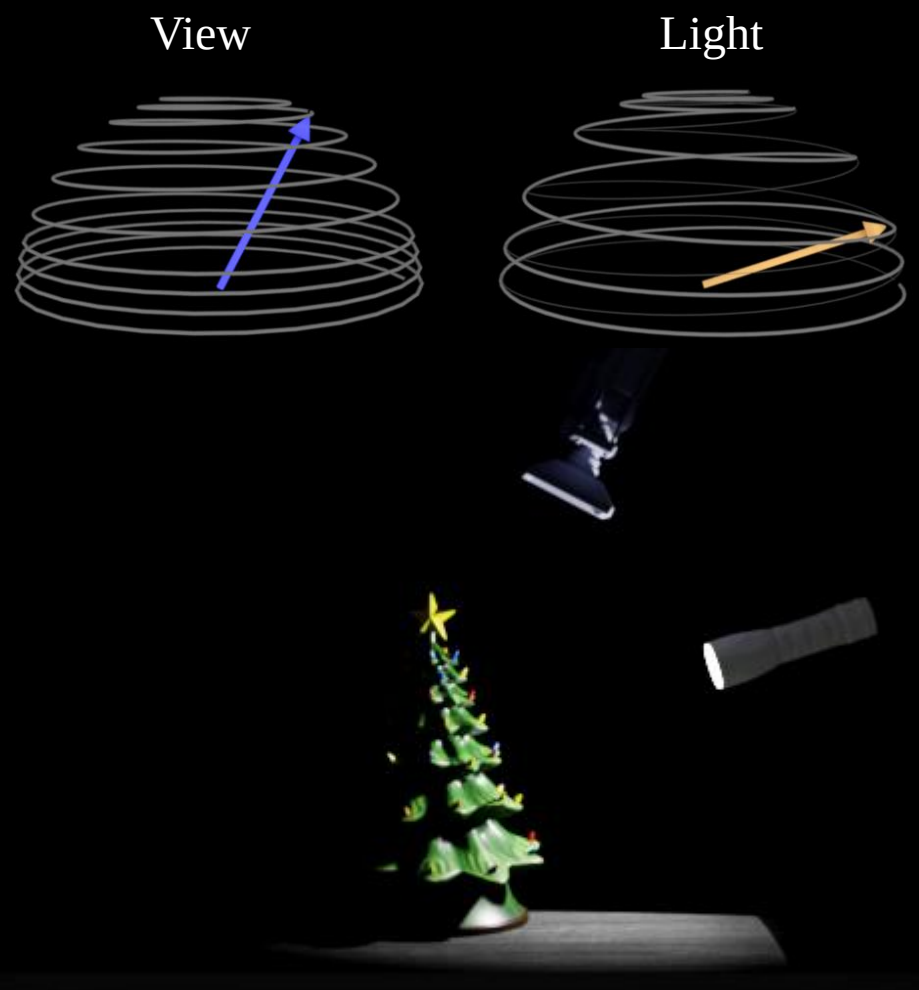
- Directly leverage the information embedded in input images.
- Generate photorealistic results without explicit modeling
- Rely on dense and complicated setup
- Major image-based methods do not support relighting.

Thies et al. 2019

Xu et al. 2019

Overview





Capturing unstructured input photographs

Overview

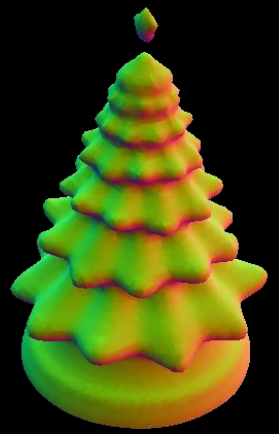
Deferred neural lighting

Unstructured photographs

360° Free-viewpoint relighting

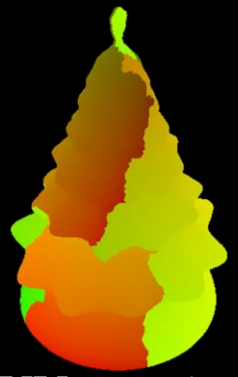
Overview

Unstructured photographs



Rough geometry

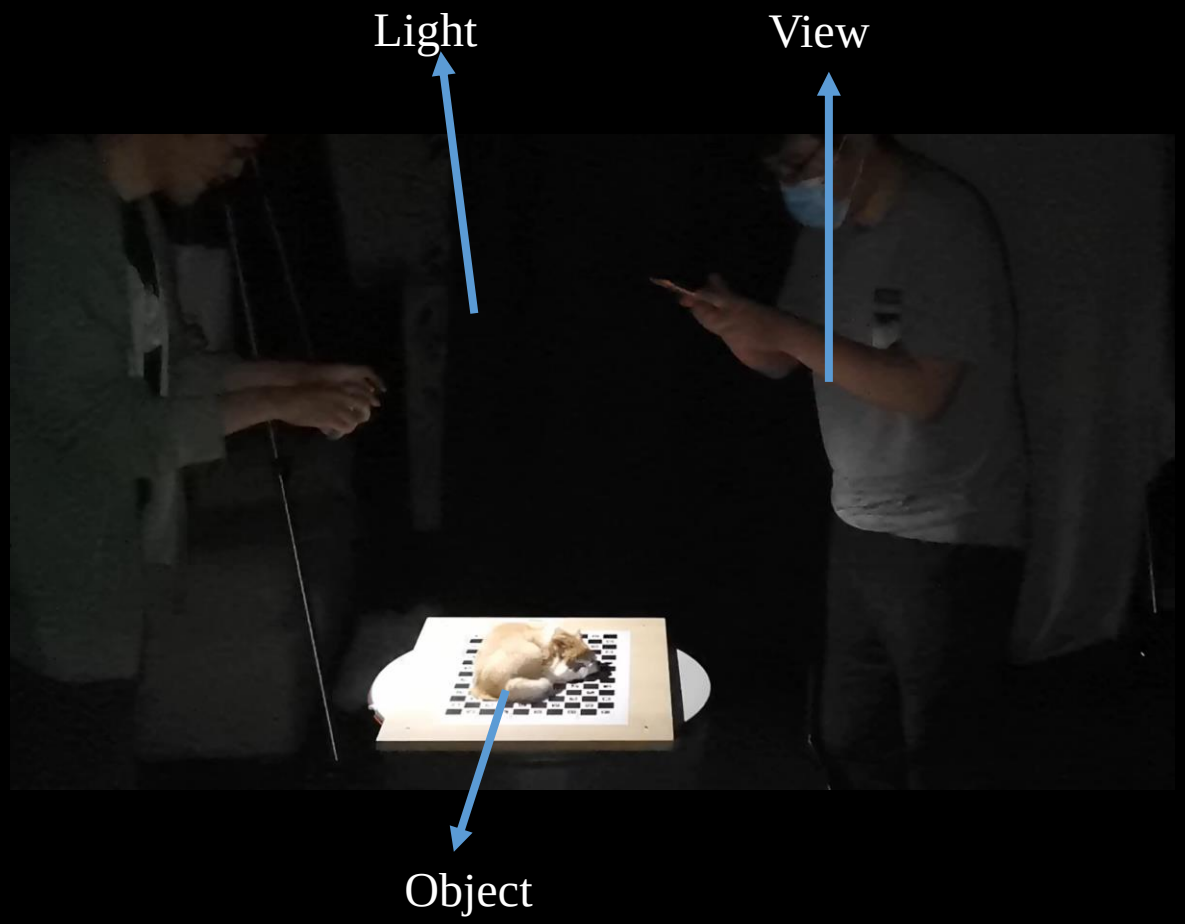
Deferred neural lighting



UV mapping

360° Free-viewpoint relighting

Our capture setup



Double hand-held devices

- Both cameras are in video mode.
- One of them with its co-located flash light turned on.
- DSLR camera or mobile phone camera.

Our capture setup

#10, 000

#10, 000

#10, 000

#13, 928

#17, 024

13, 032

#14,132

#13, 537

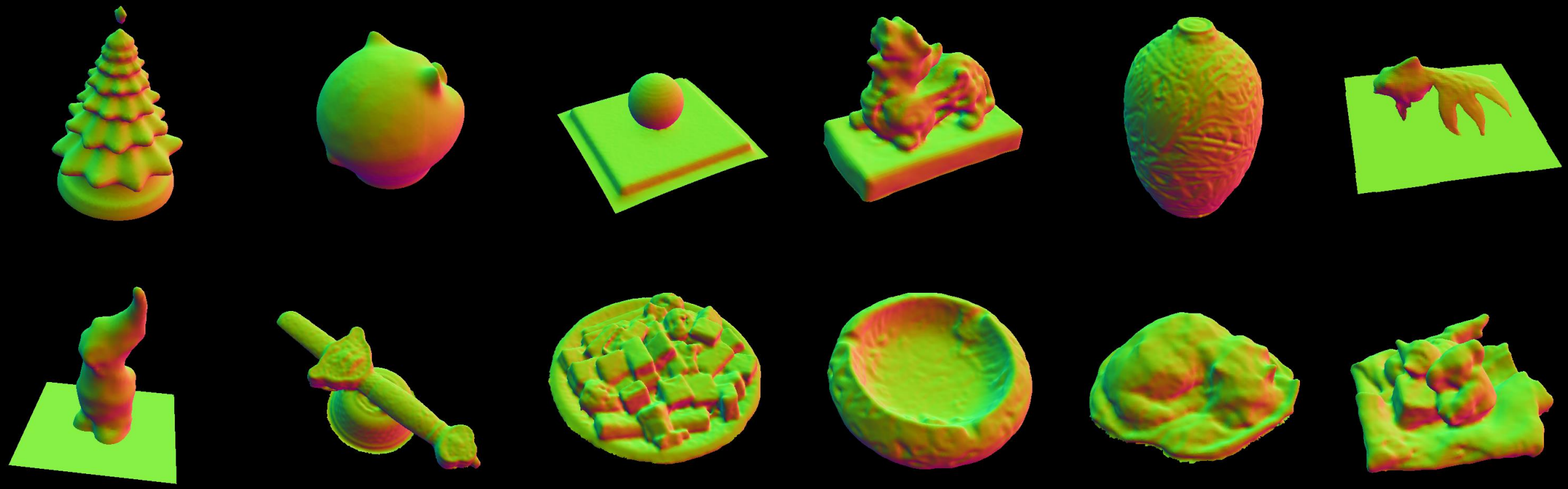
#16, 729

#19, 682

#6, 389

16, 720

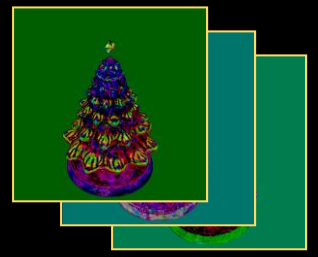
Rough geometry reconstruction



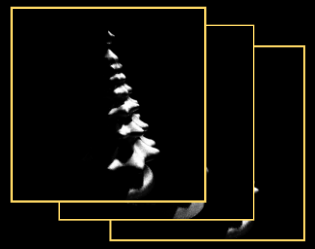
COLMAP [Schönberger and Frahm 2016]

Our method

Neural textures



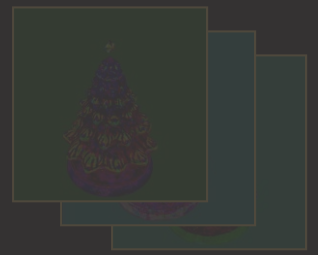
Radiance cues



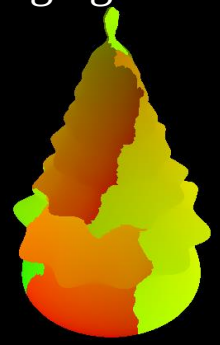
Deferred neural render

Our method

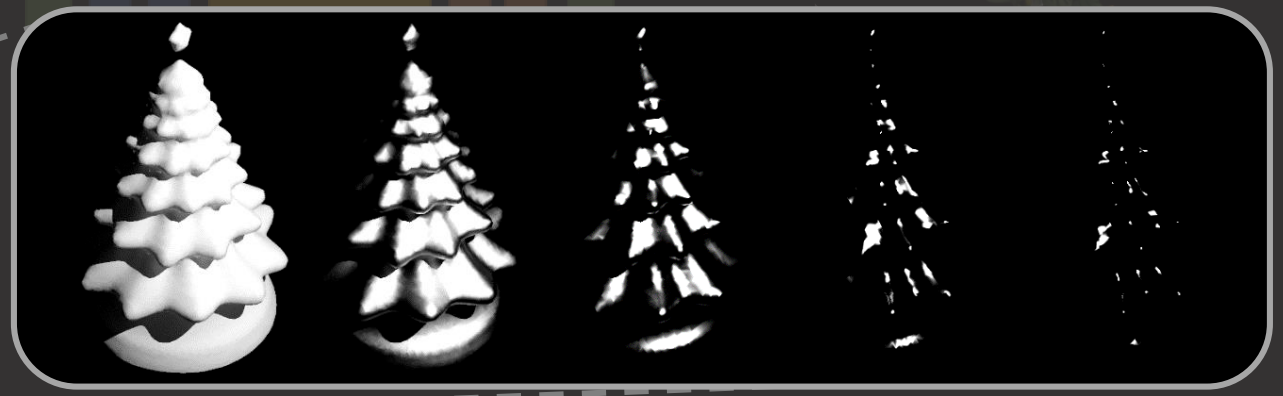
Neural textures



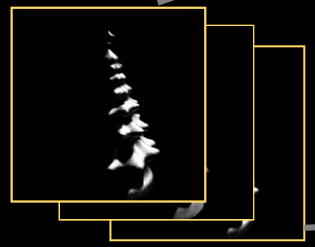
Rough geometry



Rendering



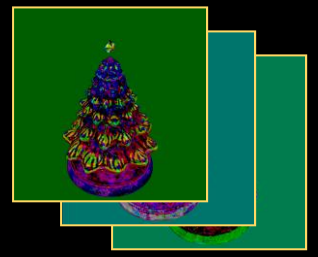
Radiance cues

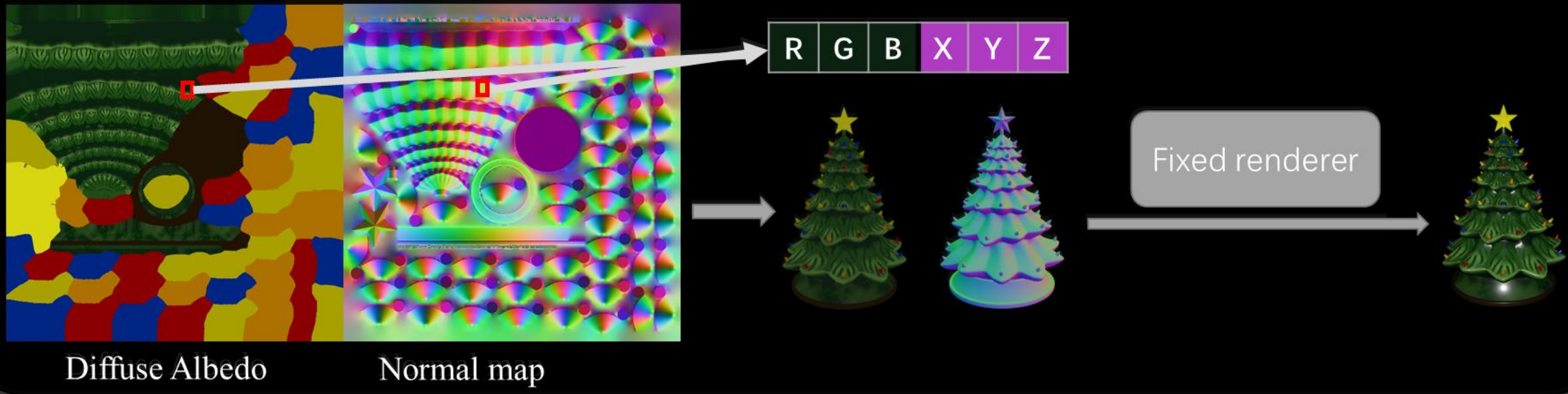


Lambertian	Cook-Torrance			
-	0.34	0.13	0.05	0.02

Our method

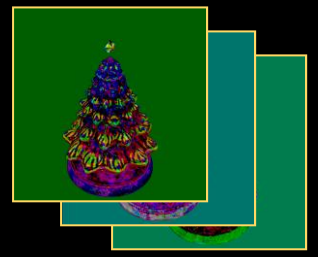
Neural textures

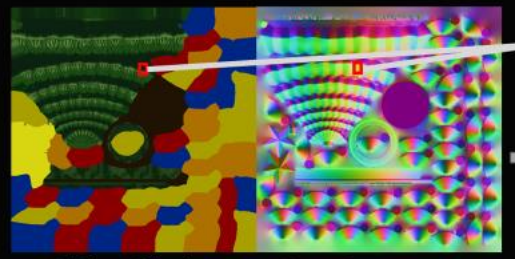




Our method

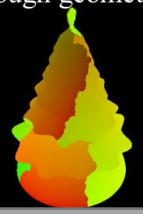
Neural textures





Neural textures

Rough geometry



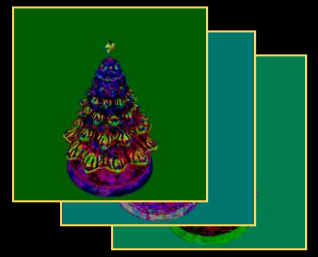
30 channels

C_1 C_2 C_3 . . . C_{28} C_{29} C_{30}

Learnable neural renderer

Our method

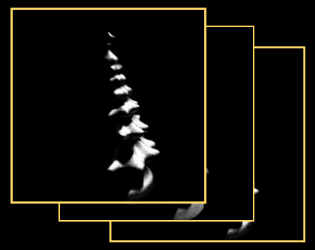
Neural textures



$Log(\odot)$

Per-pixel multiplication

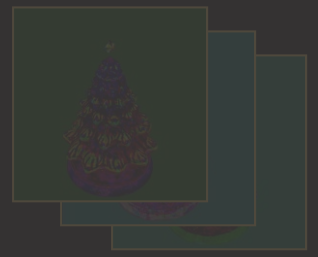
Radiance cues



Deferred neural render

Our method

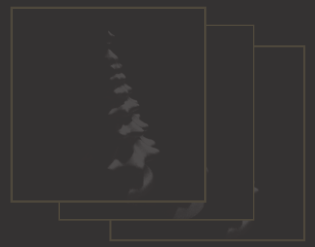
Neural textures



$Log(\odot)$

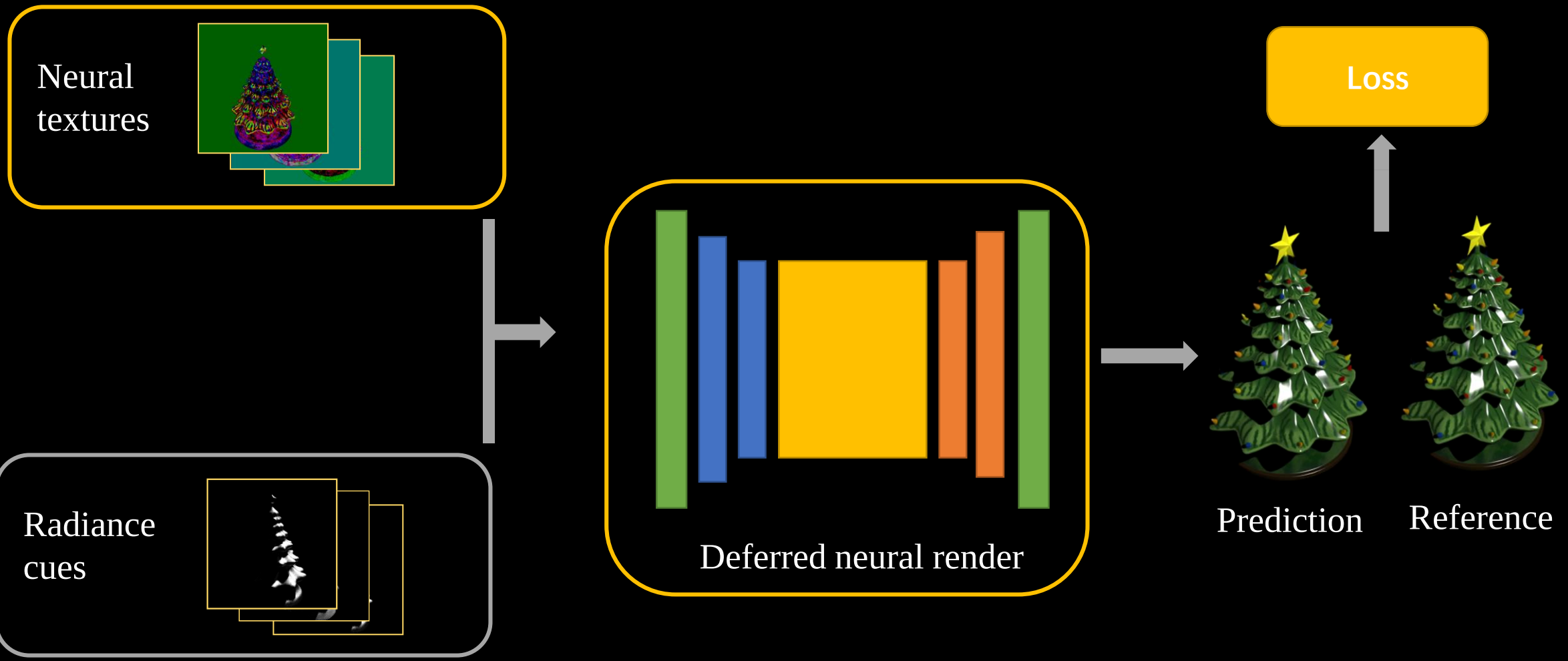
Per-pixel multiplication

Radiance cues

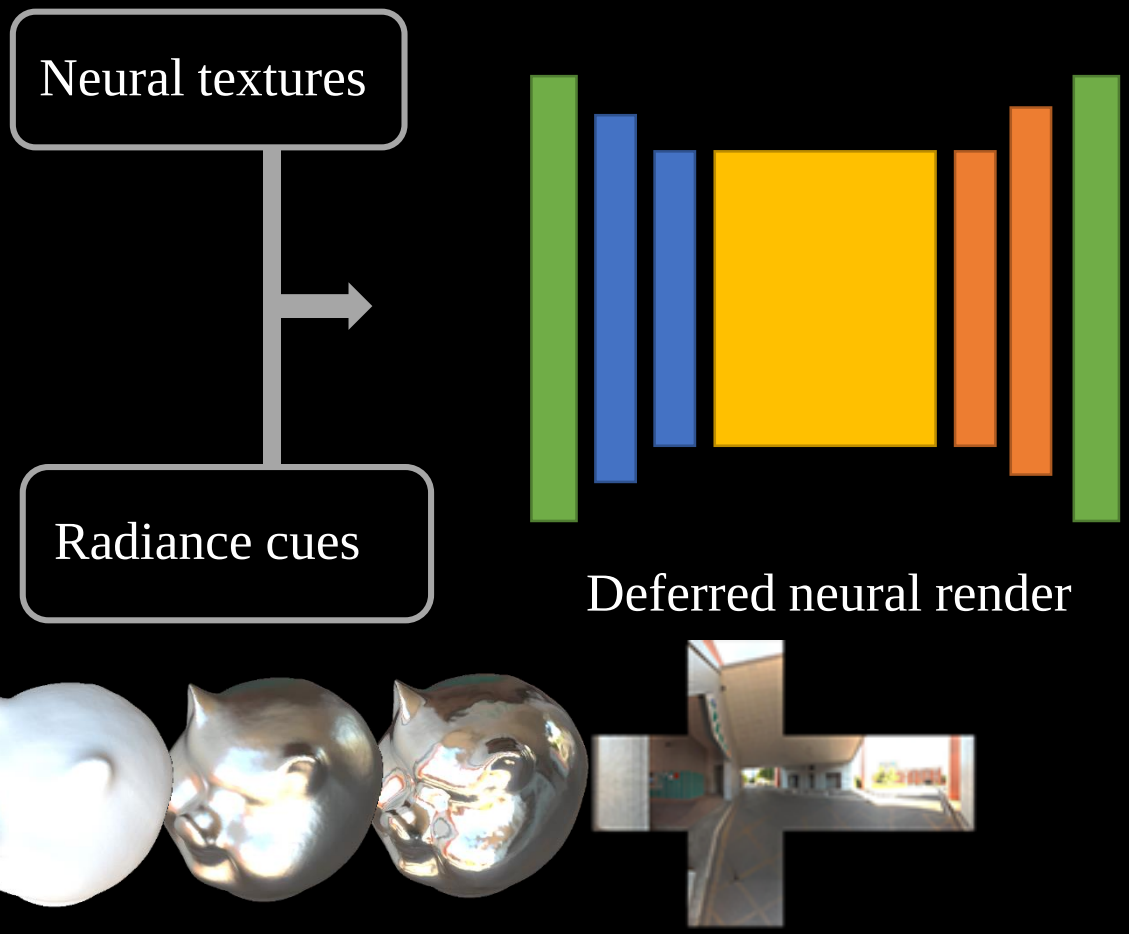


Deferred neural render

Our method


Neural textures
Radiance cues
Deferred neural render
Loss
Prediction
Reference

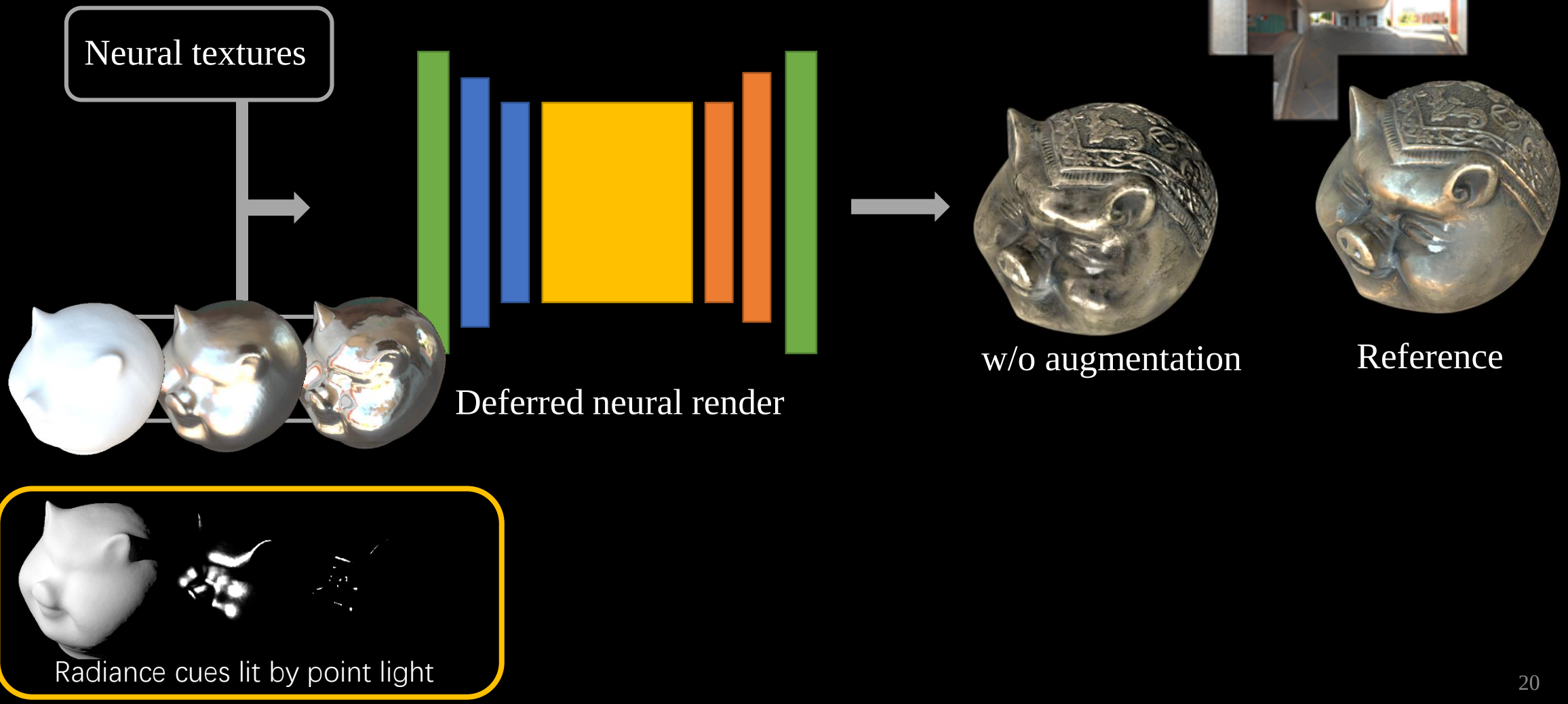
Lighting Augmentation



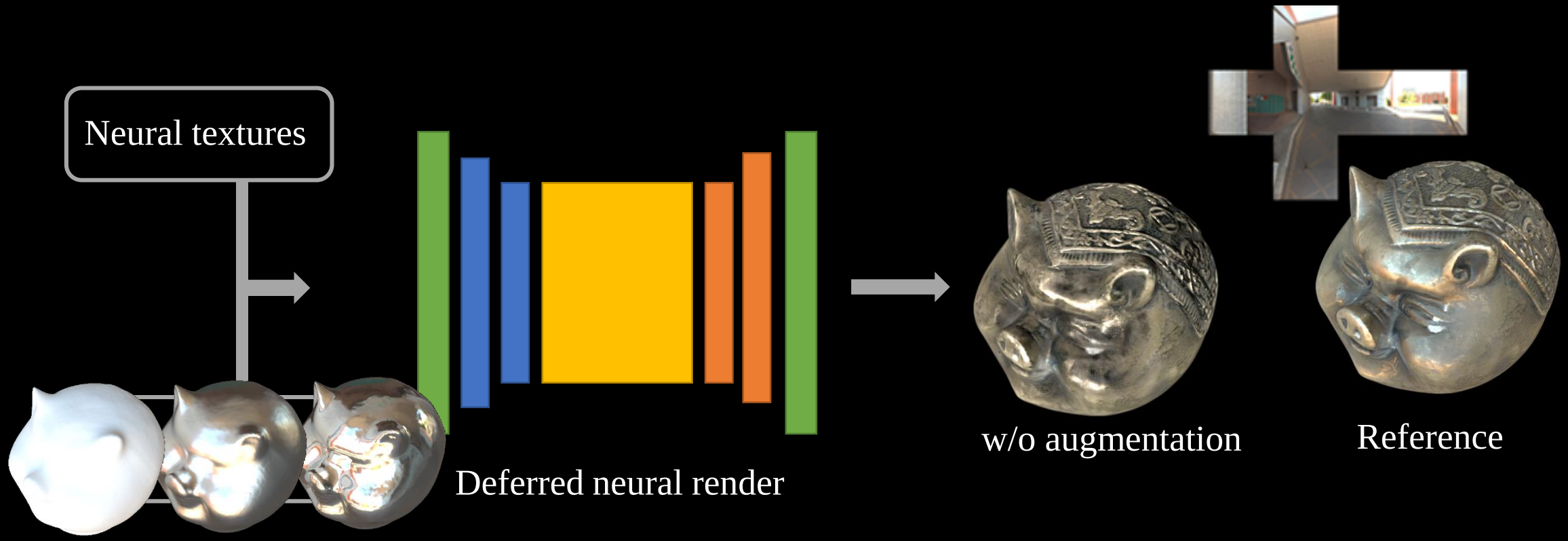
w/o augmentation

Reference

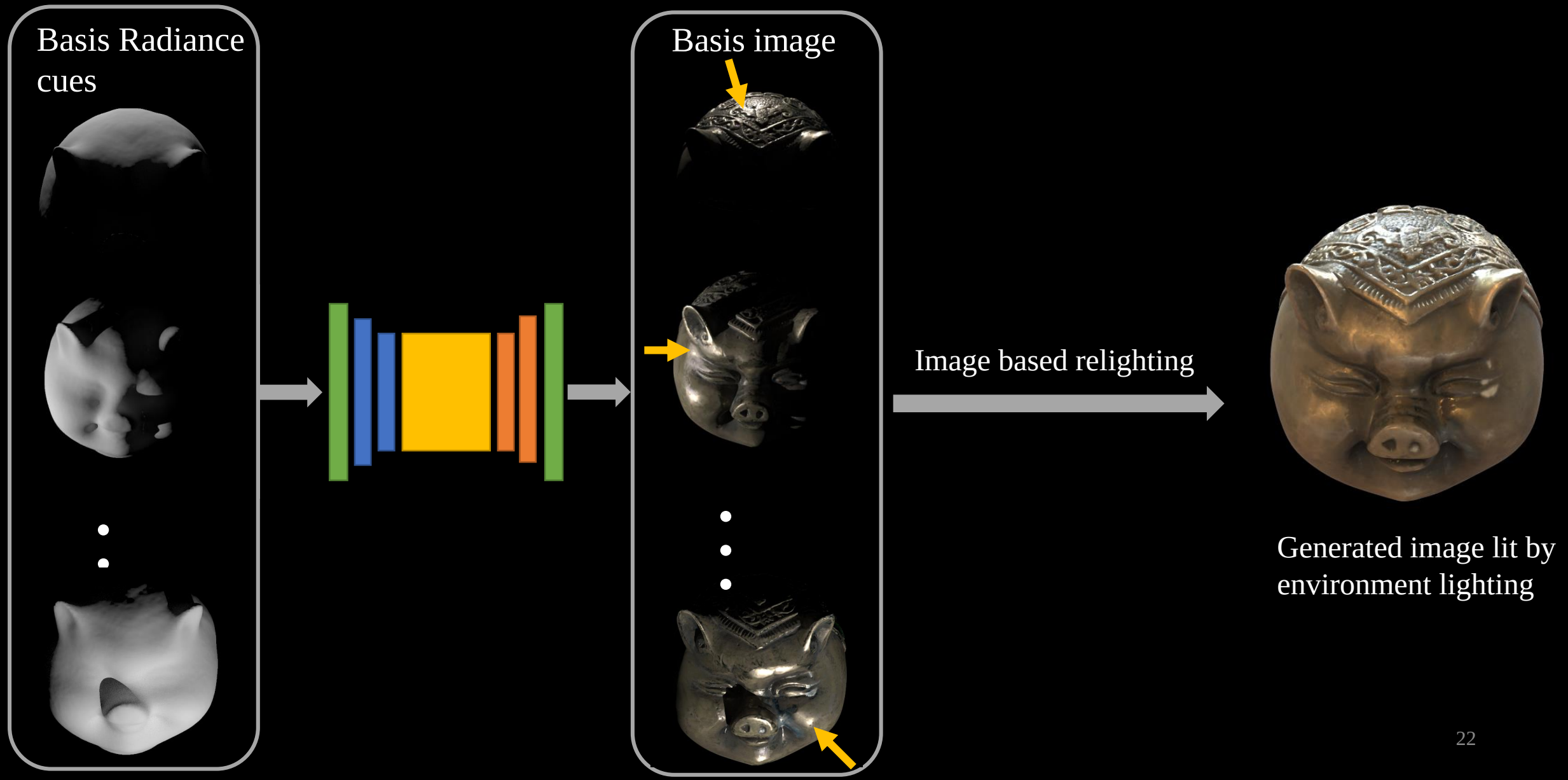
Lighting Augmentation



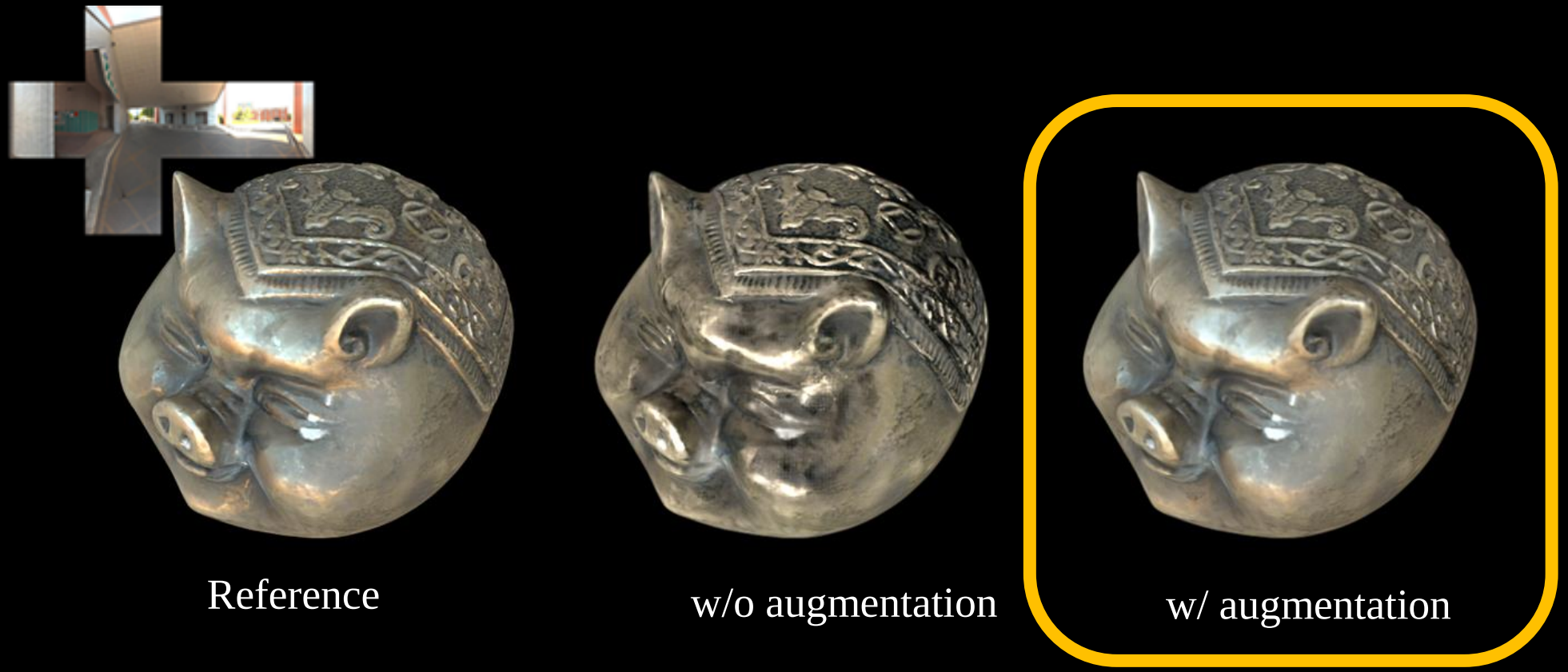
Lighting Augmentation



Lighting Augmentation



Lighting Augmentation

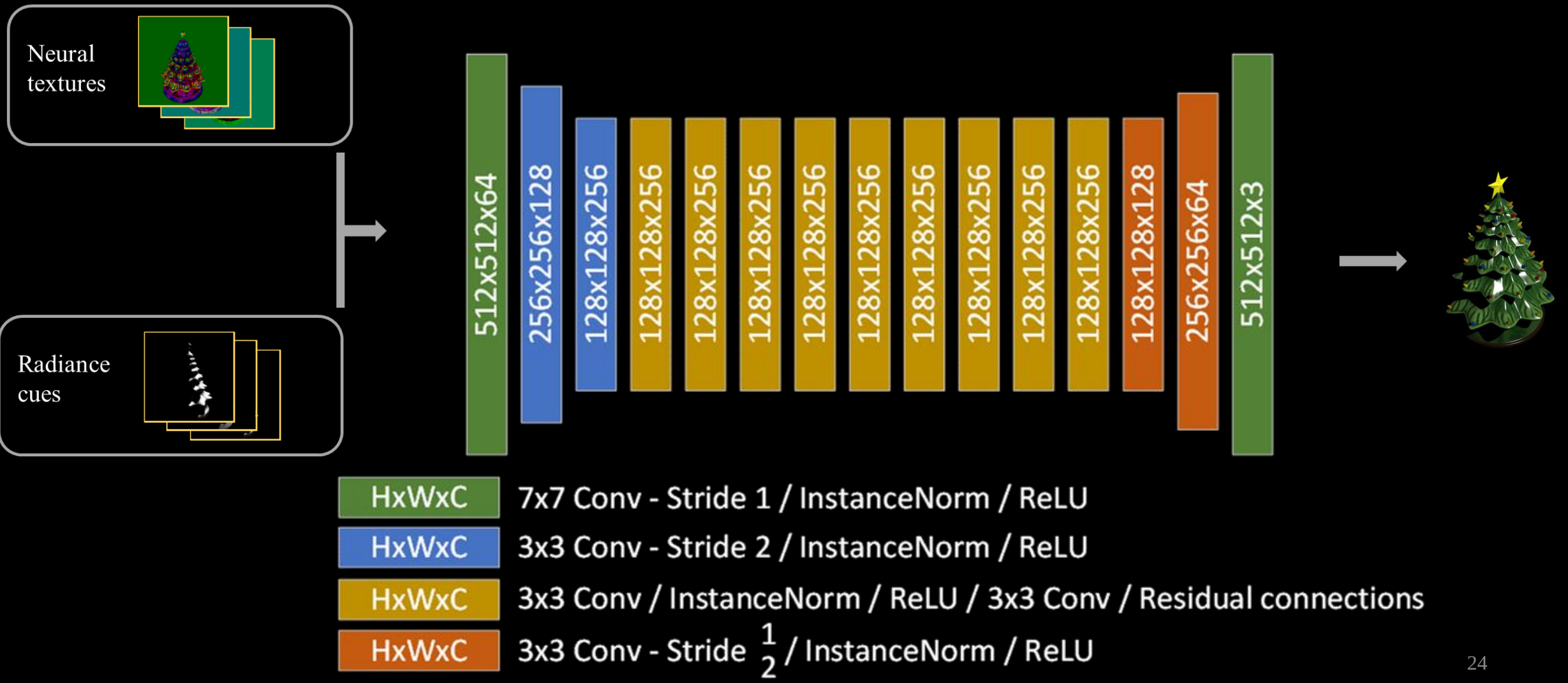


Reference

w/o augmentation

w/ augmentation

Neural Renderer Architecture



Neural Renderer Architecture

Reference

Ours

[Thies et al. 2019]-net

Radiance cues with global illumination

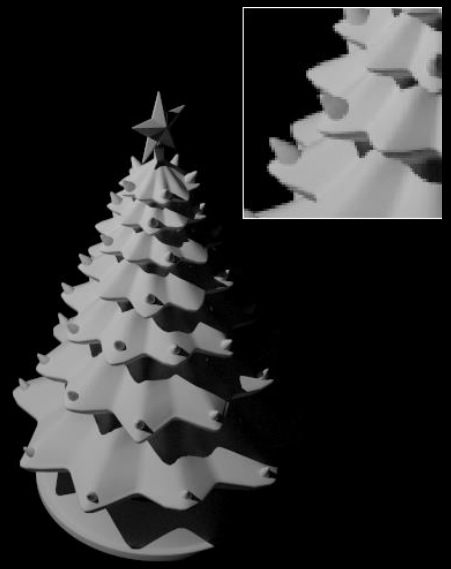
Reference

Radiance cues w/o GI

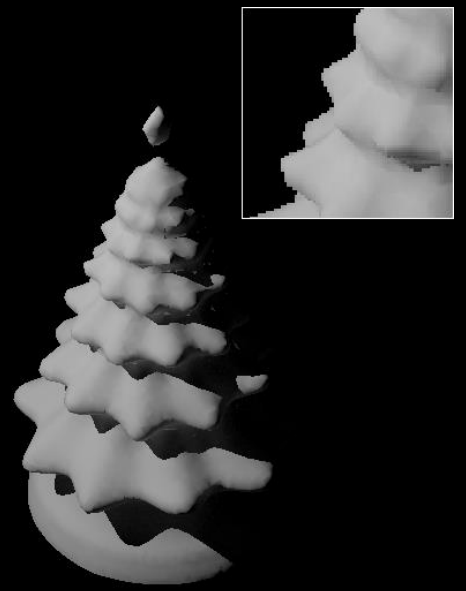
Radiance cues w/ GI

Robust to geometric errors

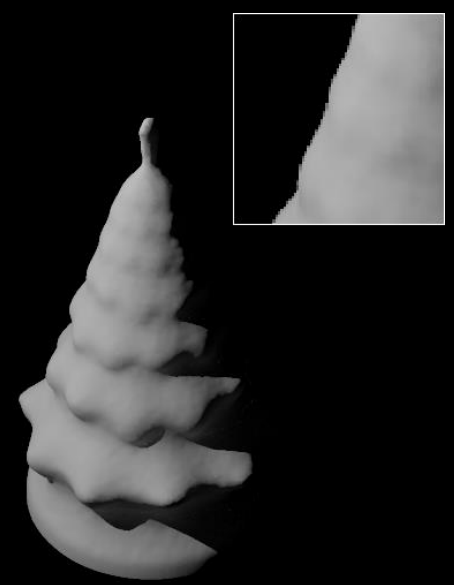
Reference



Accurate



Rough



More rough

Robust to geometric errors

Reference

1, 000 photographs

Accurate

2, 500 photographs

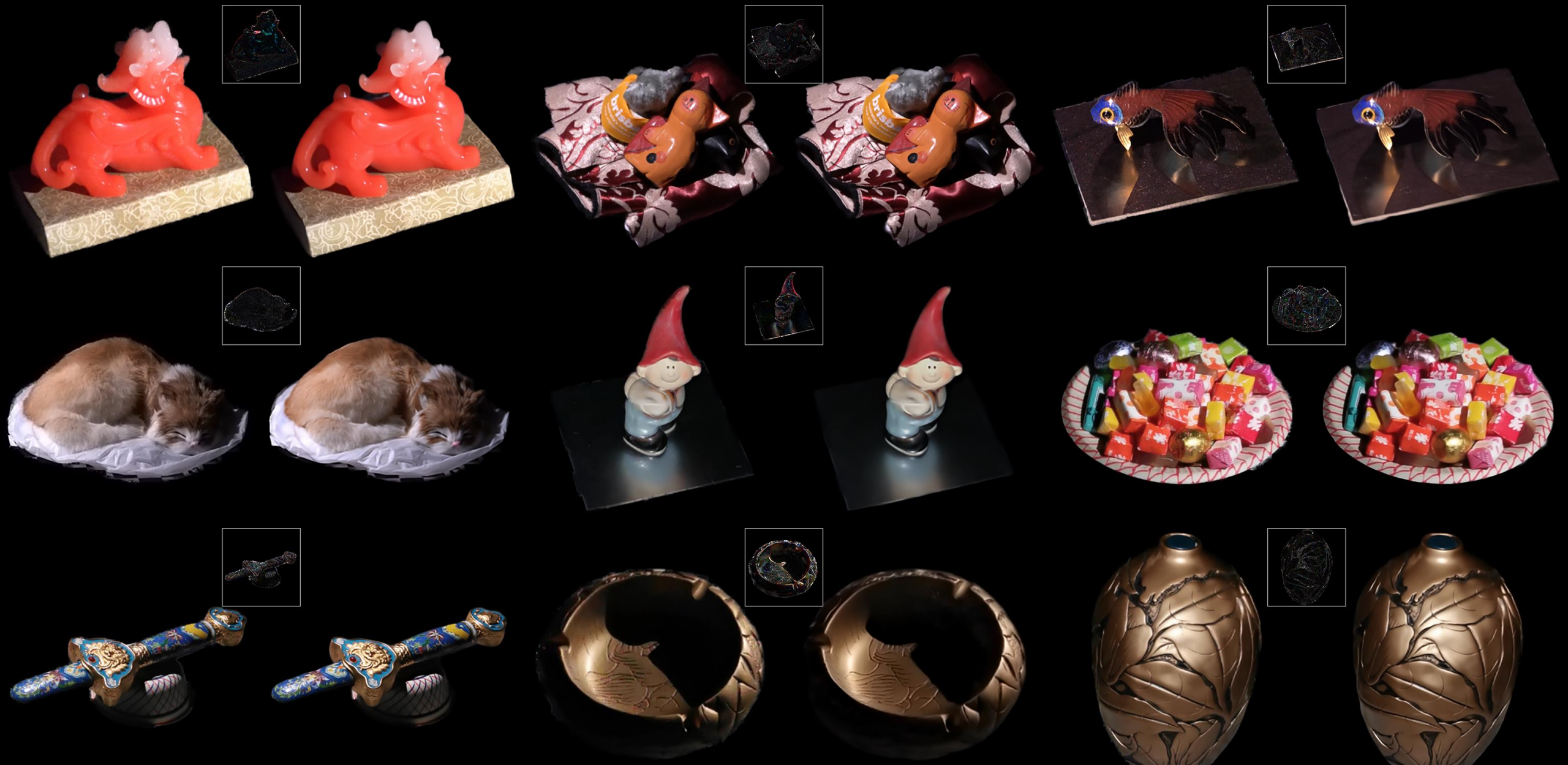
Rough

10, 000 photographs

More rough

SIGGRAPH ASIA 2020 VIRTUAL

Qualitative comparison



Real-world scenes

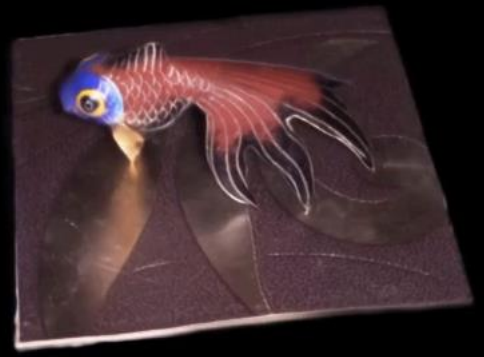
Cluttered scene
(DLSR)

Pixiu statuette
(DLSR)

Decorative sword
(Mobile phone)

Real-world scenes

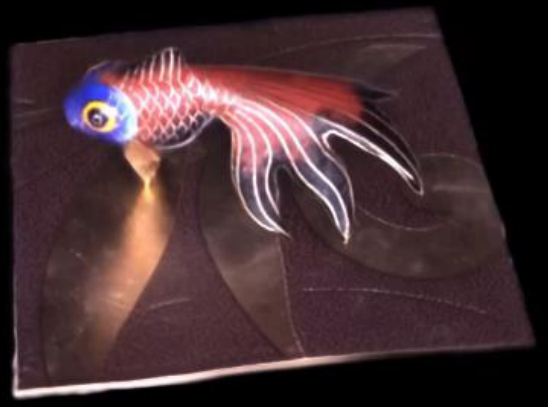
Candy bowl
(Mobile phone)



Ornamental fish
(DLSR)

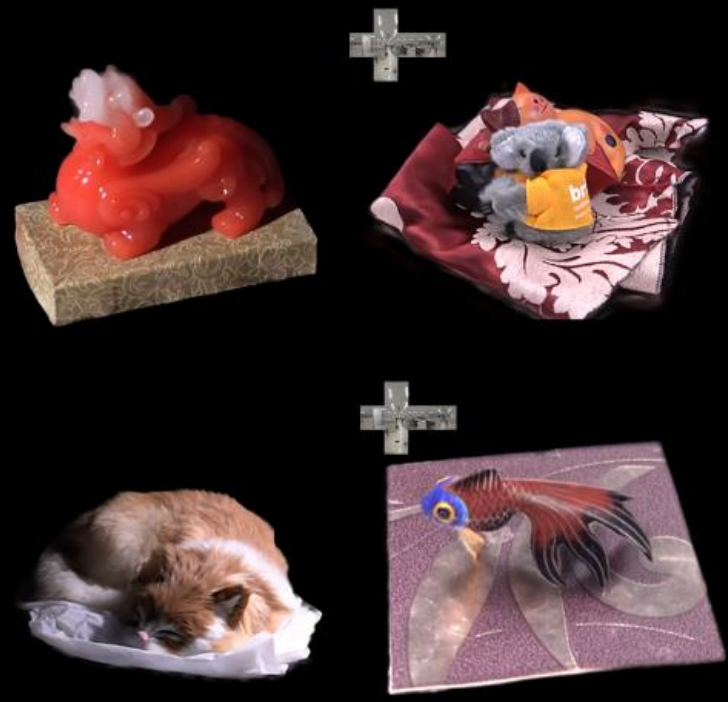
Cat
(DLSR)

Real-world scenes



Conclusion & Future work

- A novel deferred neural lighting solution
  - Enables full 360° free-viewpoint relighting from unstructured photographs.
  - Suitable for scenes captured with a novel dual handheld mobile camera setup.
  - Supports a wide range of lighting conditions.
- Future Work
  - Explore other methods for reducing the number of required photographs.



ACKNOWLEDGEMENTS

- Anonymous reviewers
- Nam et al. [2018] for helping the comparison
- Xu et al. [2018] for sharing the trained model
- NSF grant IIS-1909028
- National Natural Science Foundation of China

SIGGRAPH ASIA 2020 VIRTUAL

Thanks