

Local Shape Editing at the Compositing Stage

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Inria



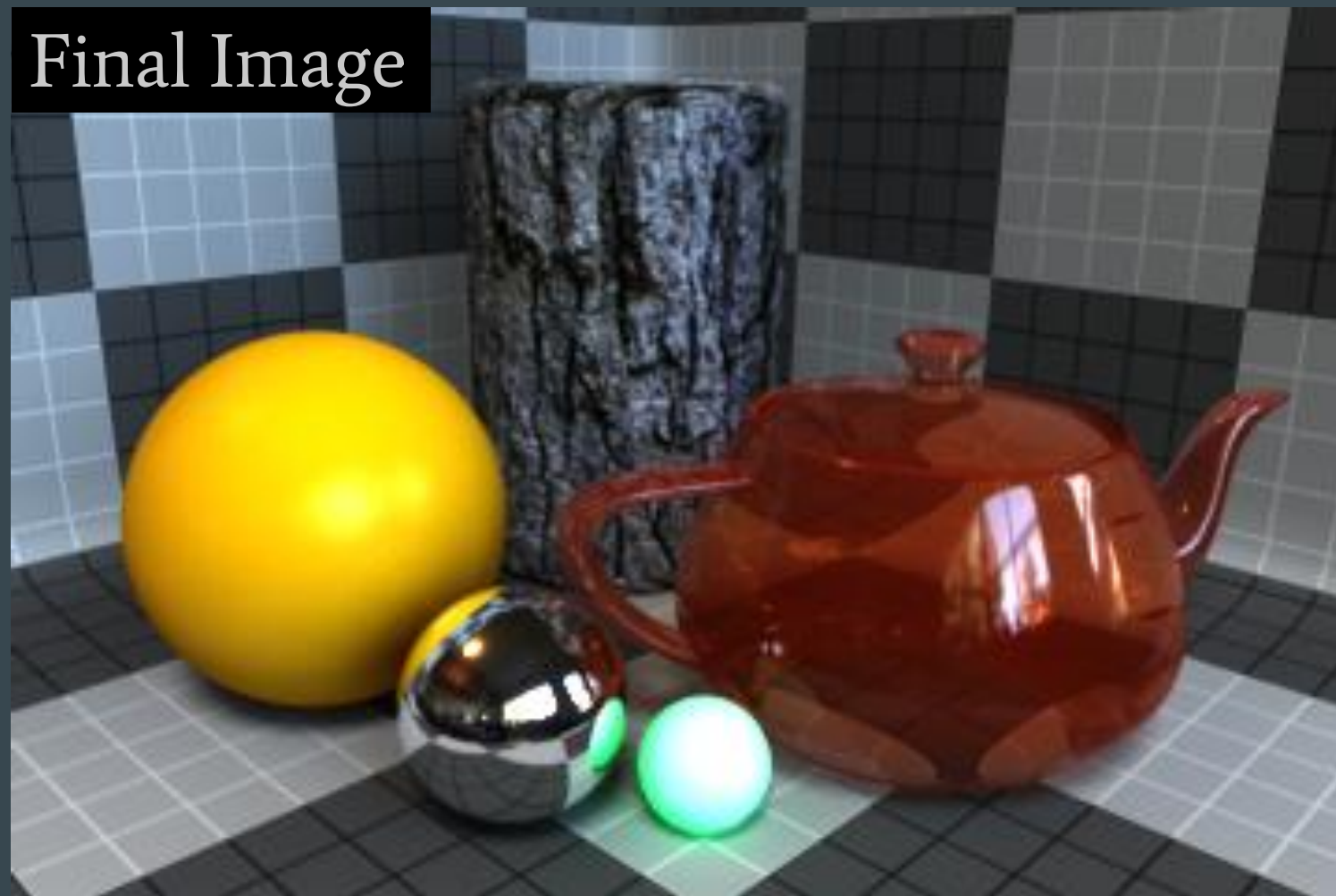
prism



Trinity
College
Dublin

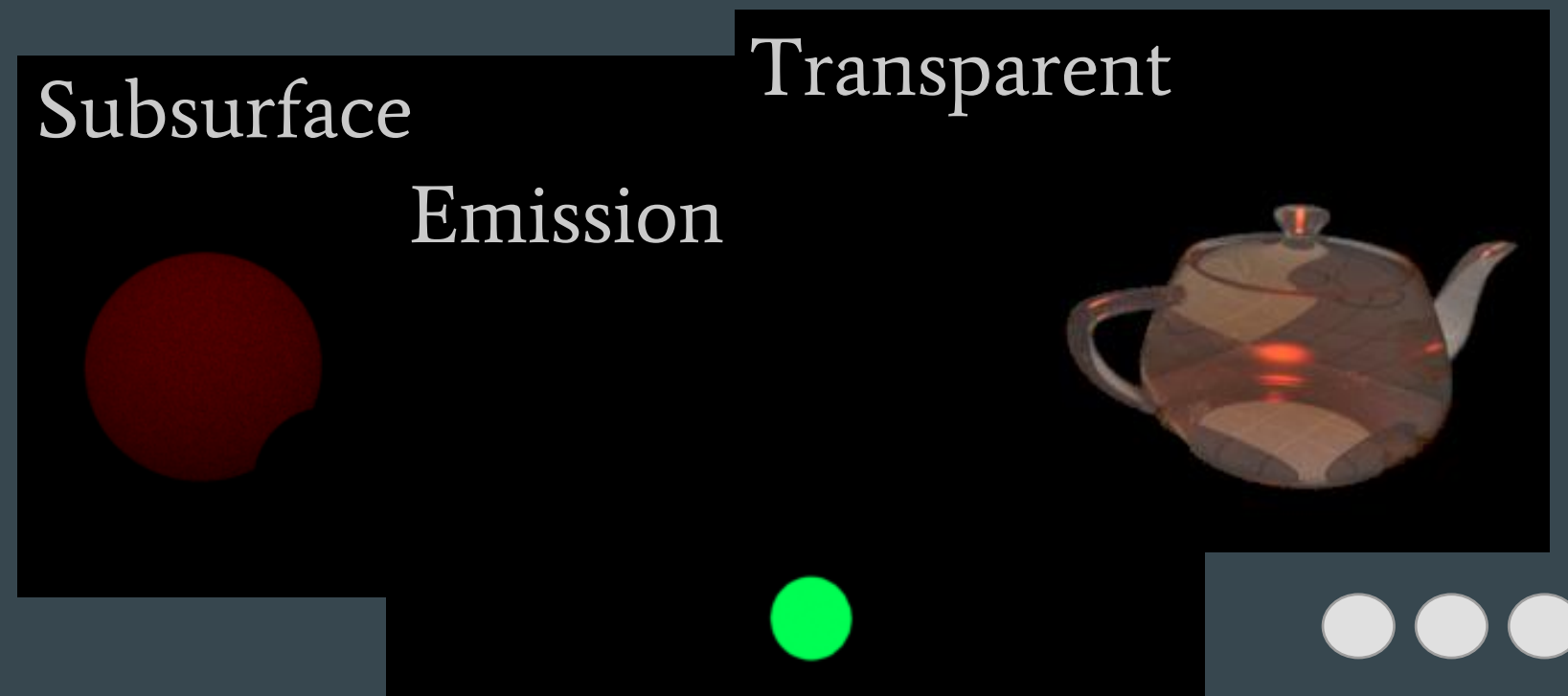
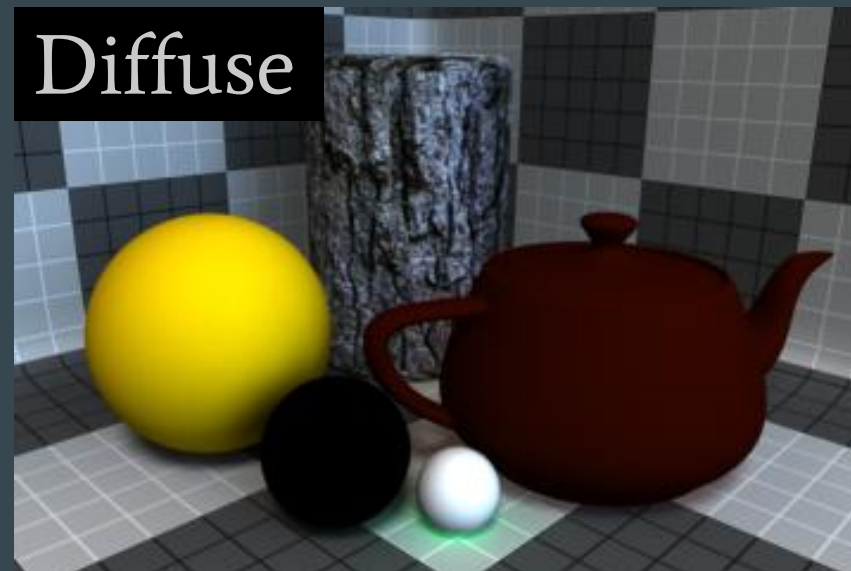
The University of Dublin

Compositing



Σ

Shading Buffers



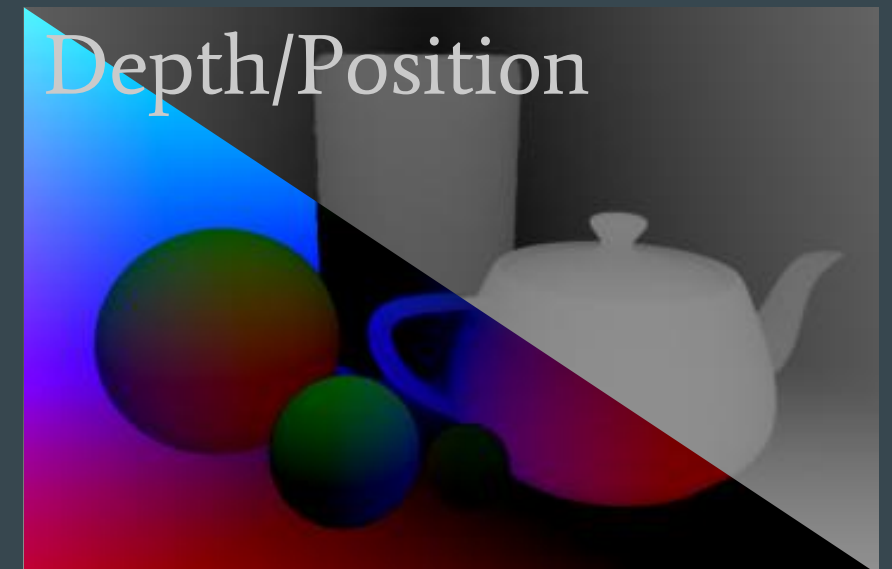
Compositing

Secondary Buffers

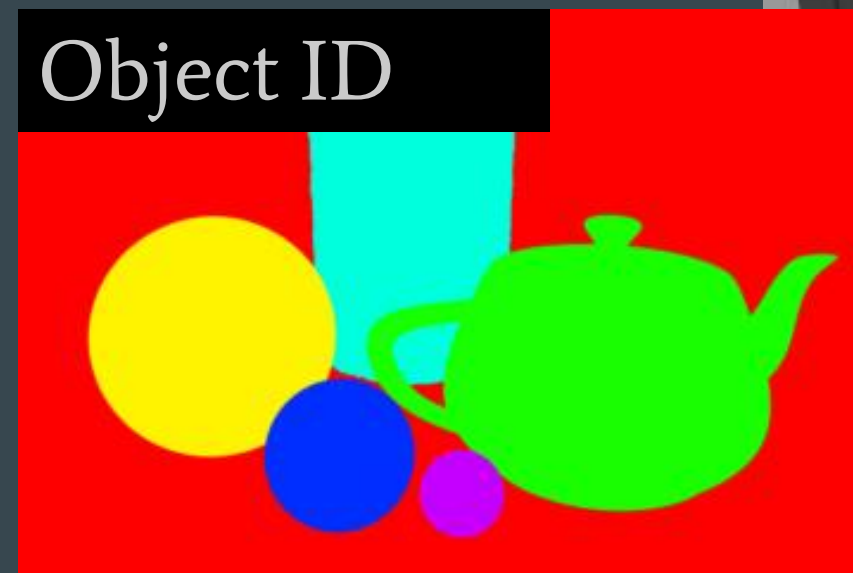
Normals



Depth/Position



Object ID



Diffuse Coeff.

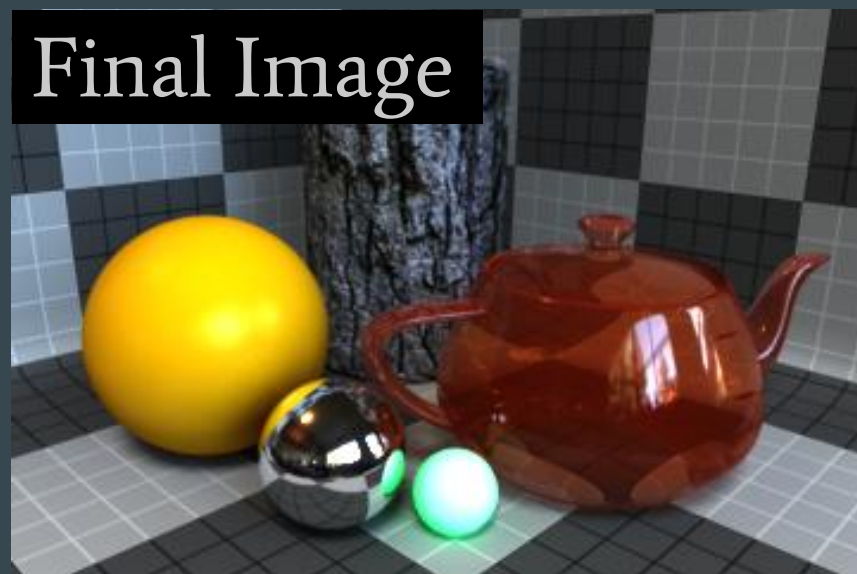
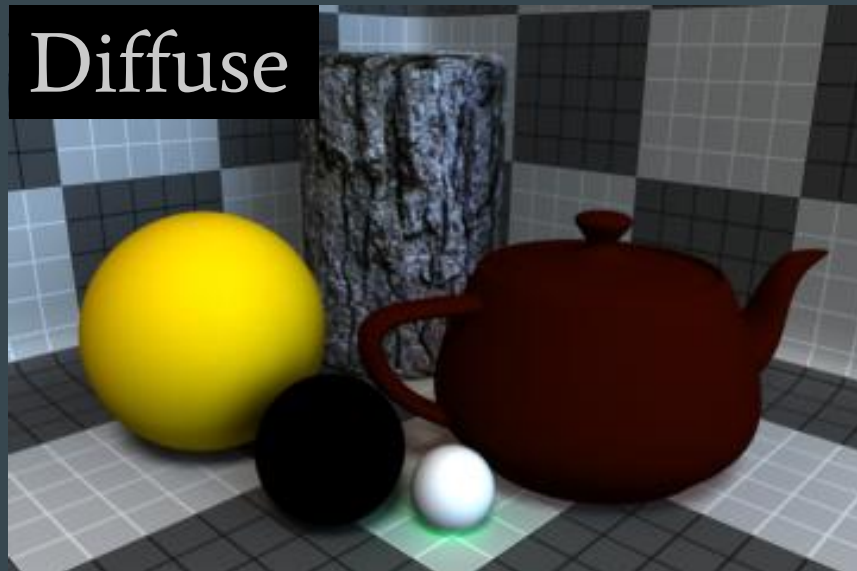


Ambient Occ.

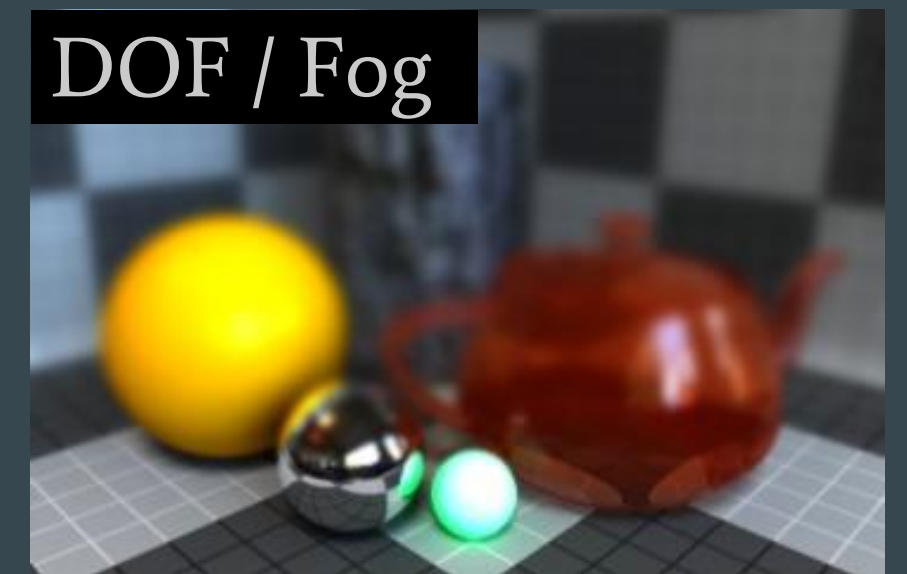
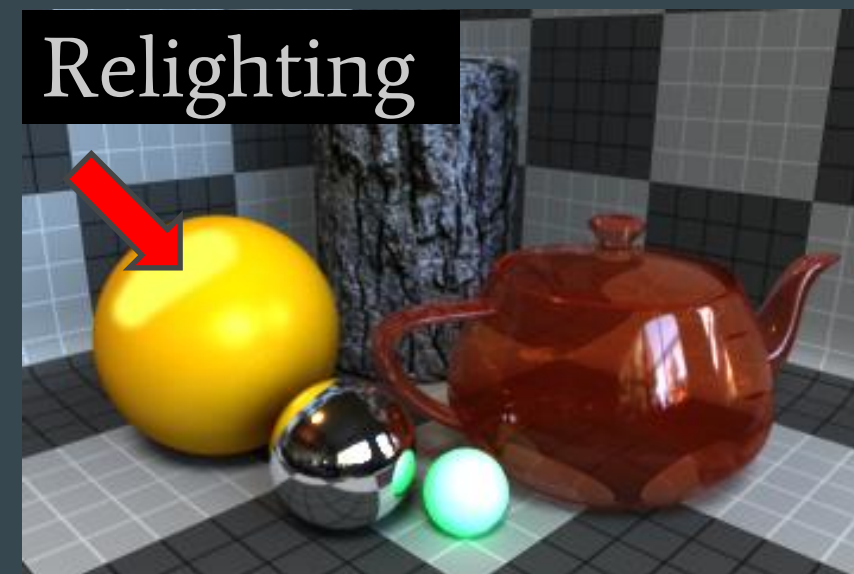
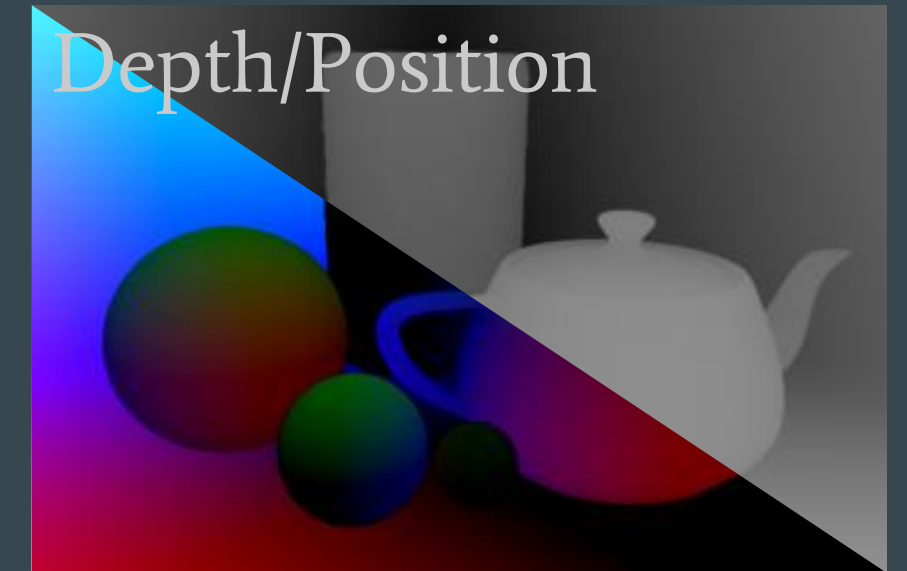


Compositing Effects

Shading Buffers

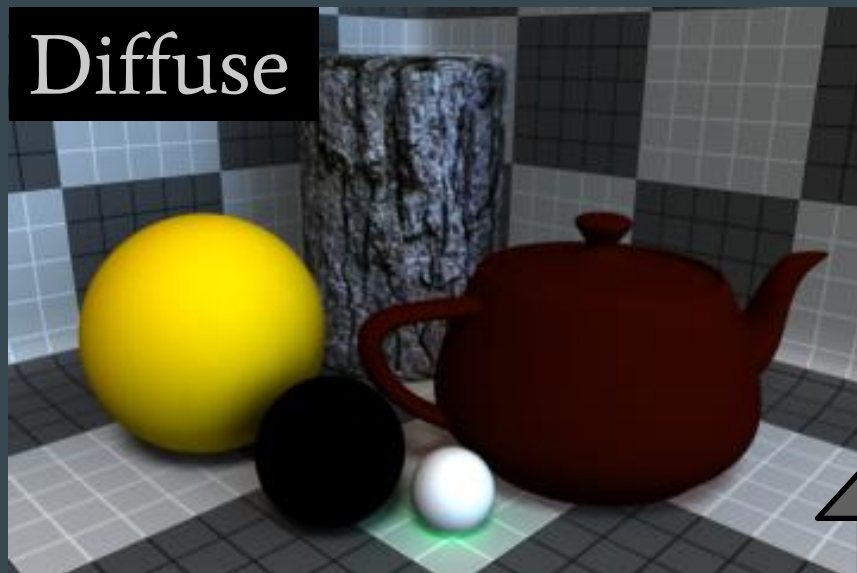


Auxiliary Buffers

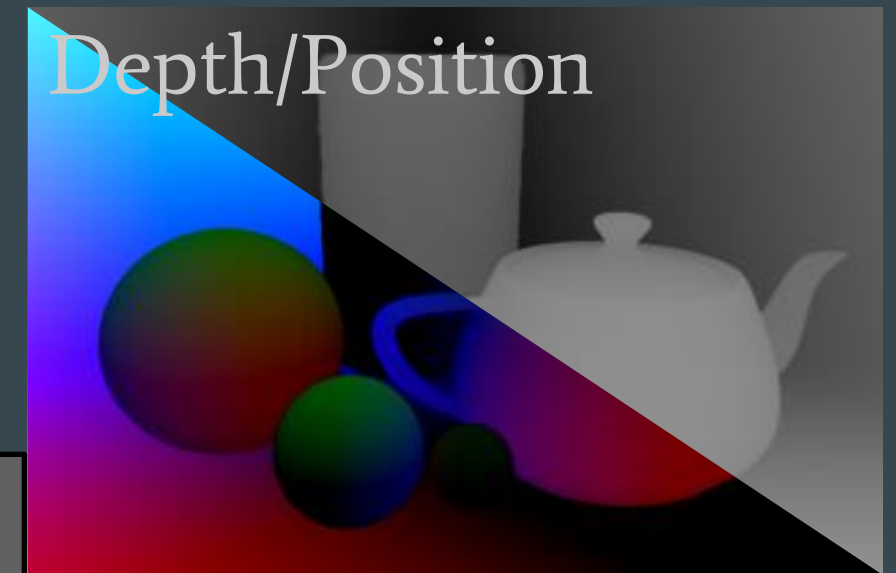


Compositing Effects **Limitations**

Shading Buffers



Auxiliary Buffers



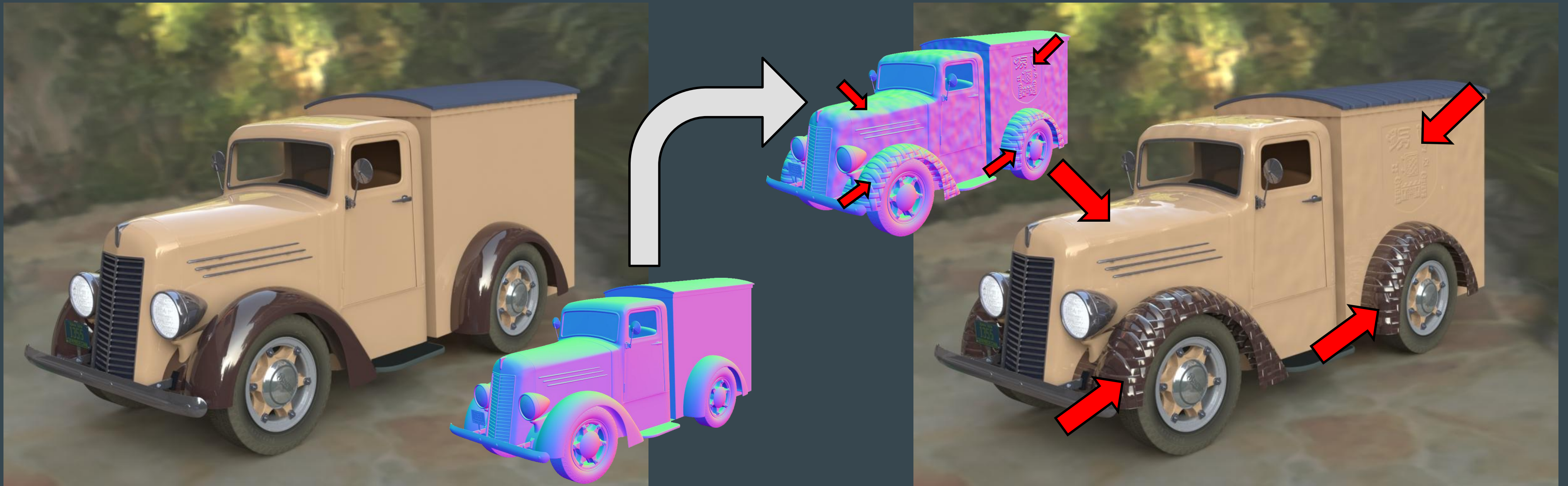
Shape modifications do not change shading

Lighting is lost in the rendering process

Costly re-rendering is needed

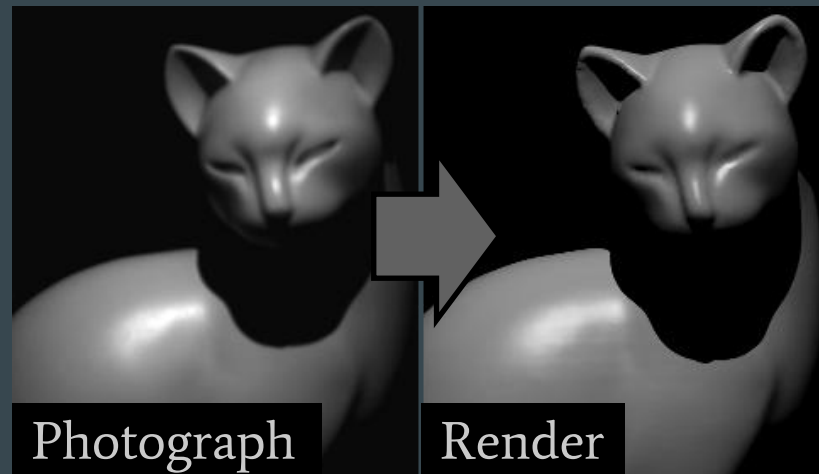
Goal

Grant real-time **local shape** modification in post-processing in a **plausible** way



Previous Work

Lighting Reconstruction



A Signal-Processing Framework for Inverse Rendering
[Ramammorthi et al 01]

- Inverse Rendering is an ill-Posed Problem



Reflectance and Natural Illumination from a
Single Image [Lombardi et al 12]

- Assume natural lighting and low entropy
- Statistical BRDFs and a low detail lighting

Decoupling of lighting and material is
not necessary to manipulate appearance

Appearance Manipulation I

Image Based Material Editing
[Khan et al 06]

- Estimates of 3D shape & lighting for re-rendering



Interactive Reflection Editing
[Ritschel et al 09]

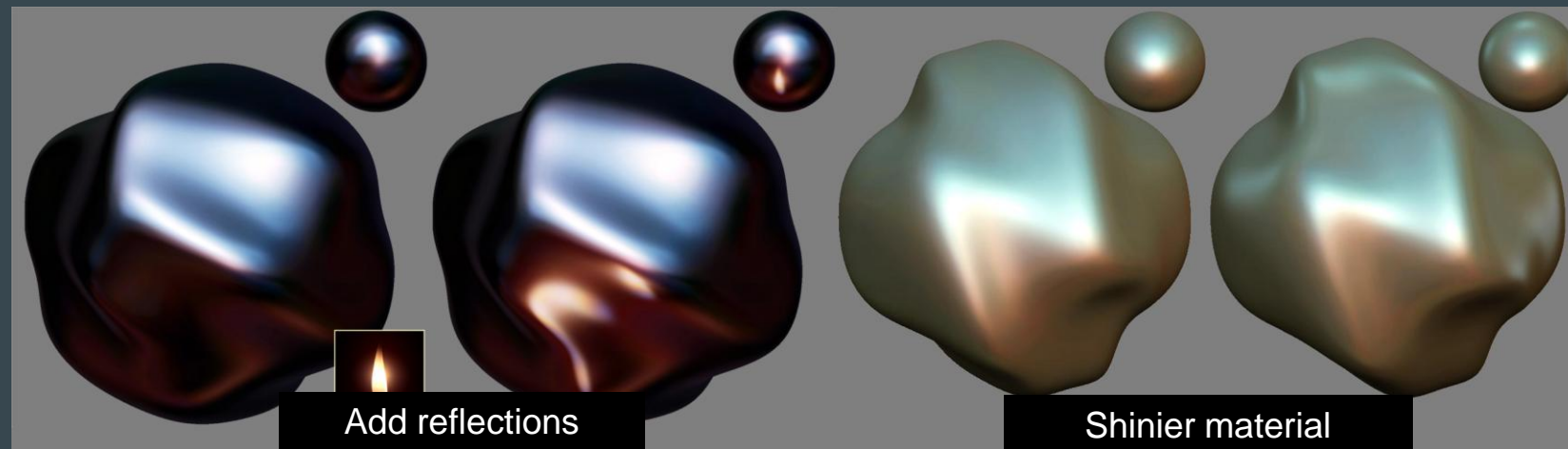
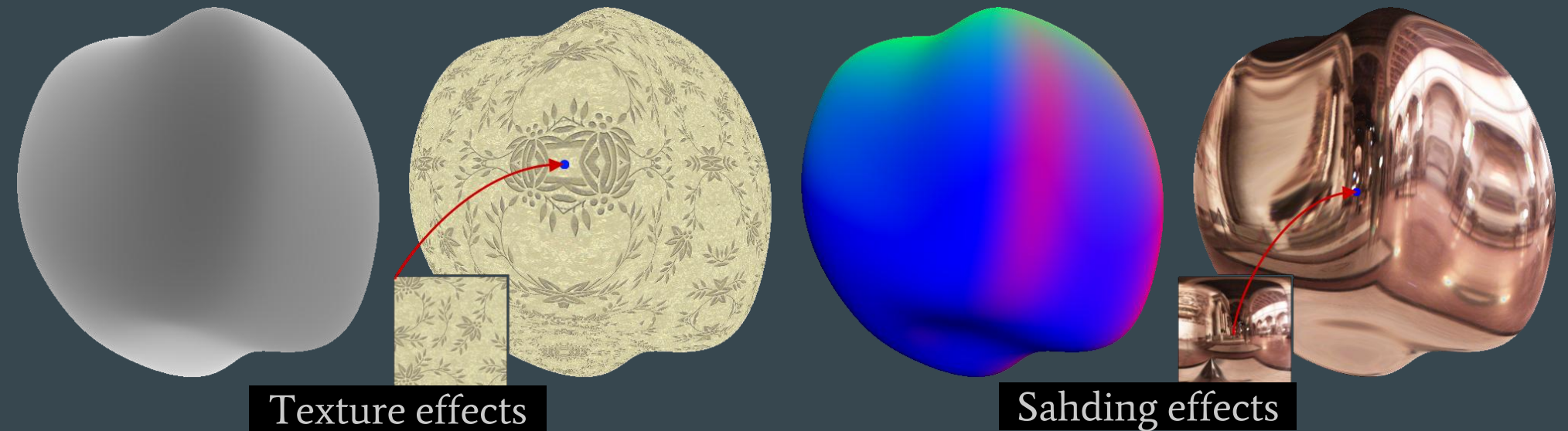
- Manipulate reflections on 3D away from physical restrictions

Manipulation performed in full 3D:
not adapted to compositing

Appearance Manipulation II

Surface flows for image-based shading design [Vergne et al 12]

- Use depth and normal buffers to deform/warp images



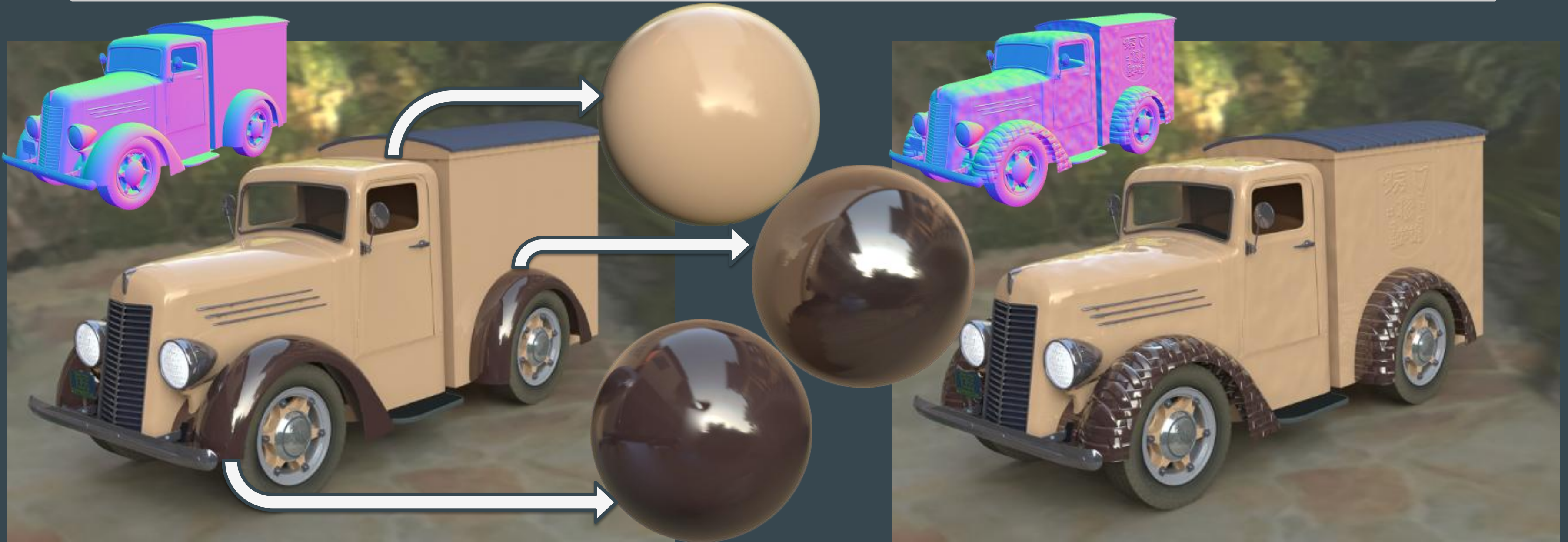
MatCap Decomposition for Dynamic Appearance Manipulation [Zubiaga et al 15]

- Modify lighting and material appearance from MatCaps
- Avoid decoupling of lighting and material

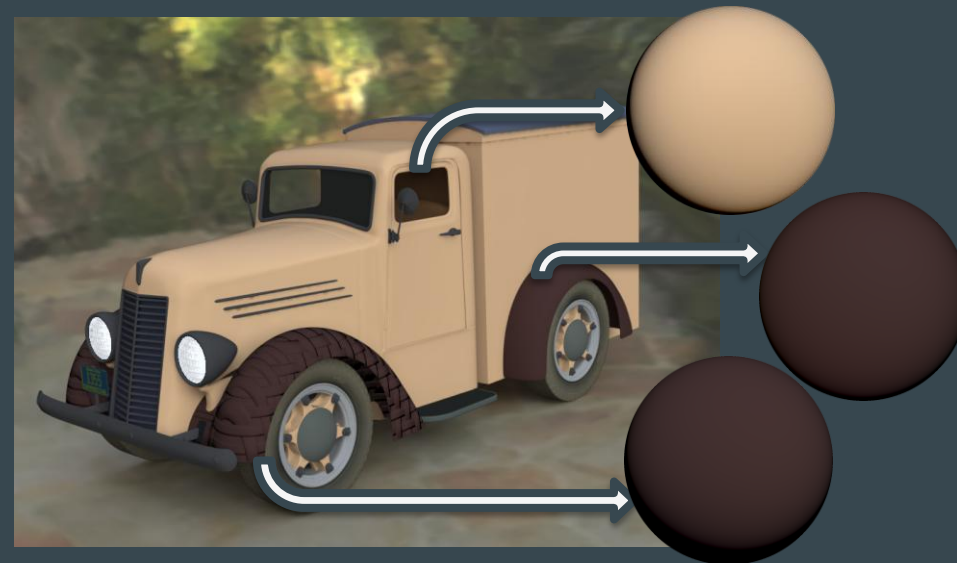
A novel approach to manipulate **existing** appearance in **complex** renderings is required

Main Idea

Reconstruct Pre-filtered Environment Maps (PEM) per object/material

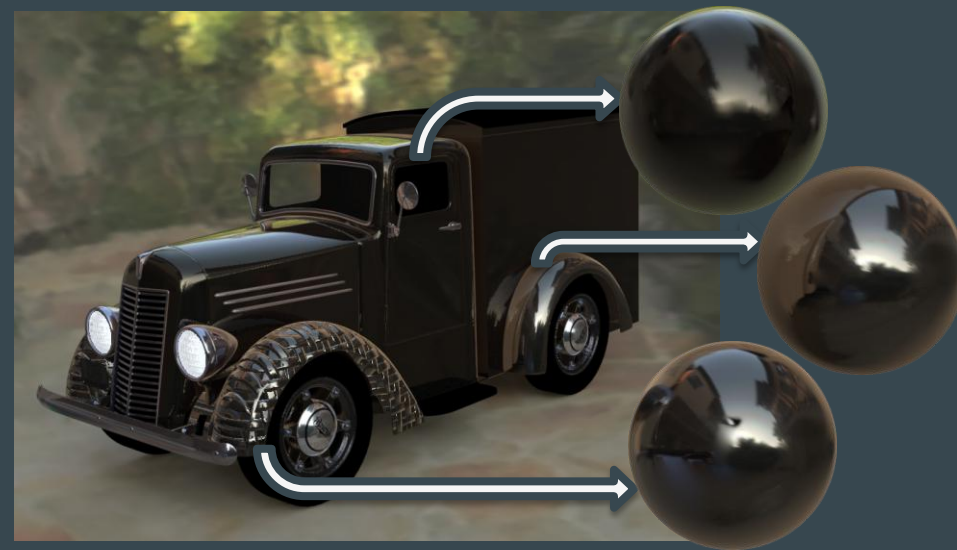


Frequency-dependent Reconstruction Approach



Diffuse

- Low-Frequency
- Spherical Harmonics

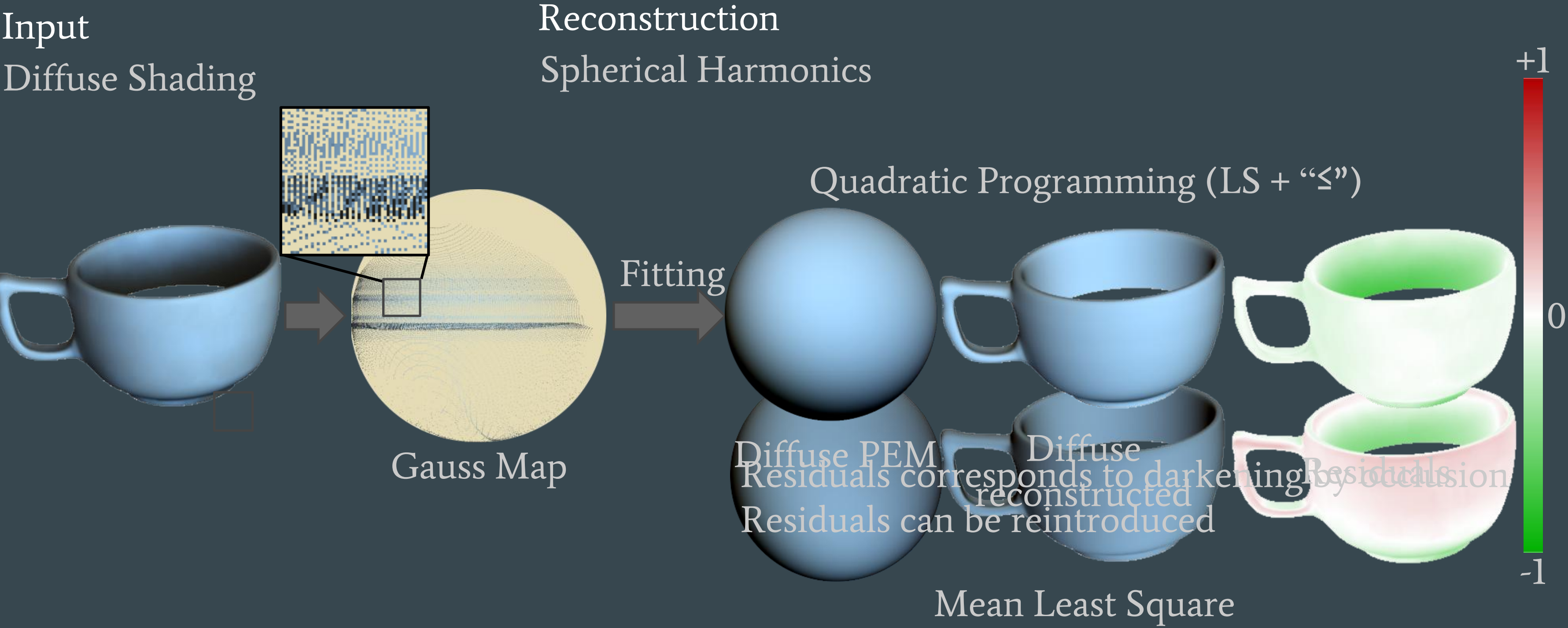


Reflections

- High-Frequency
- Detailed PEM

Reconstruction

Diffuse Reconstruction



Reflection Reconstruction

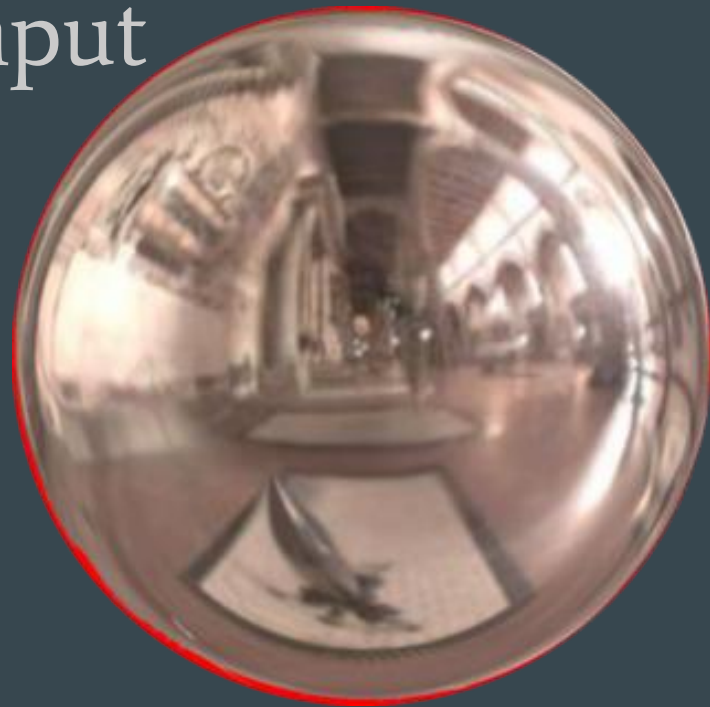
High Resolution



- Blurred Weighting
- Spherical Harmonics
- Discontinuous quadrates

Reflection Reconstruction

Input



Front
Dual Paraboloid Map

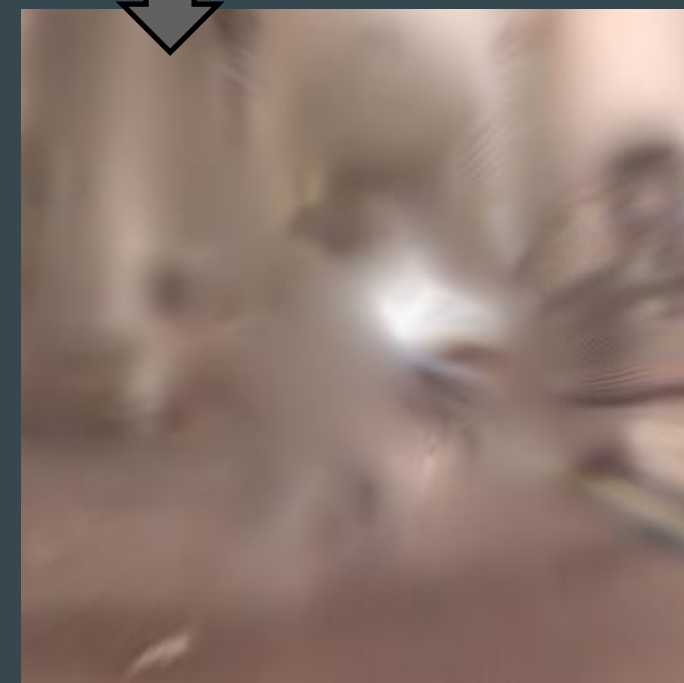


Back

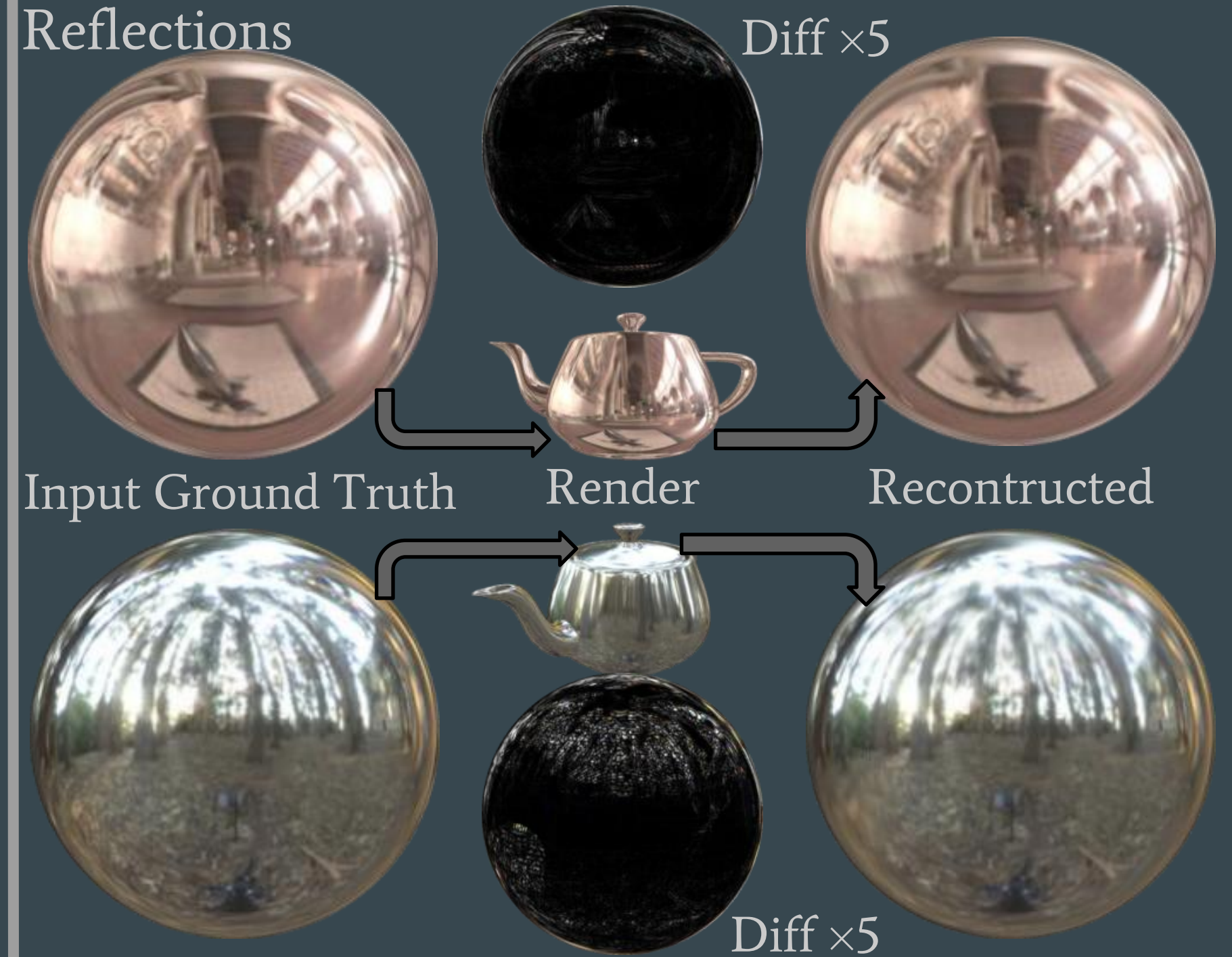
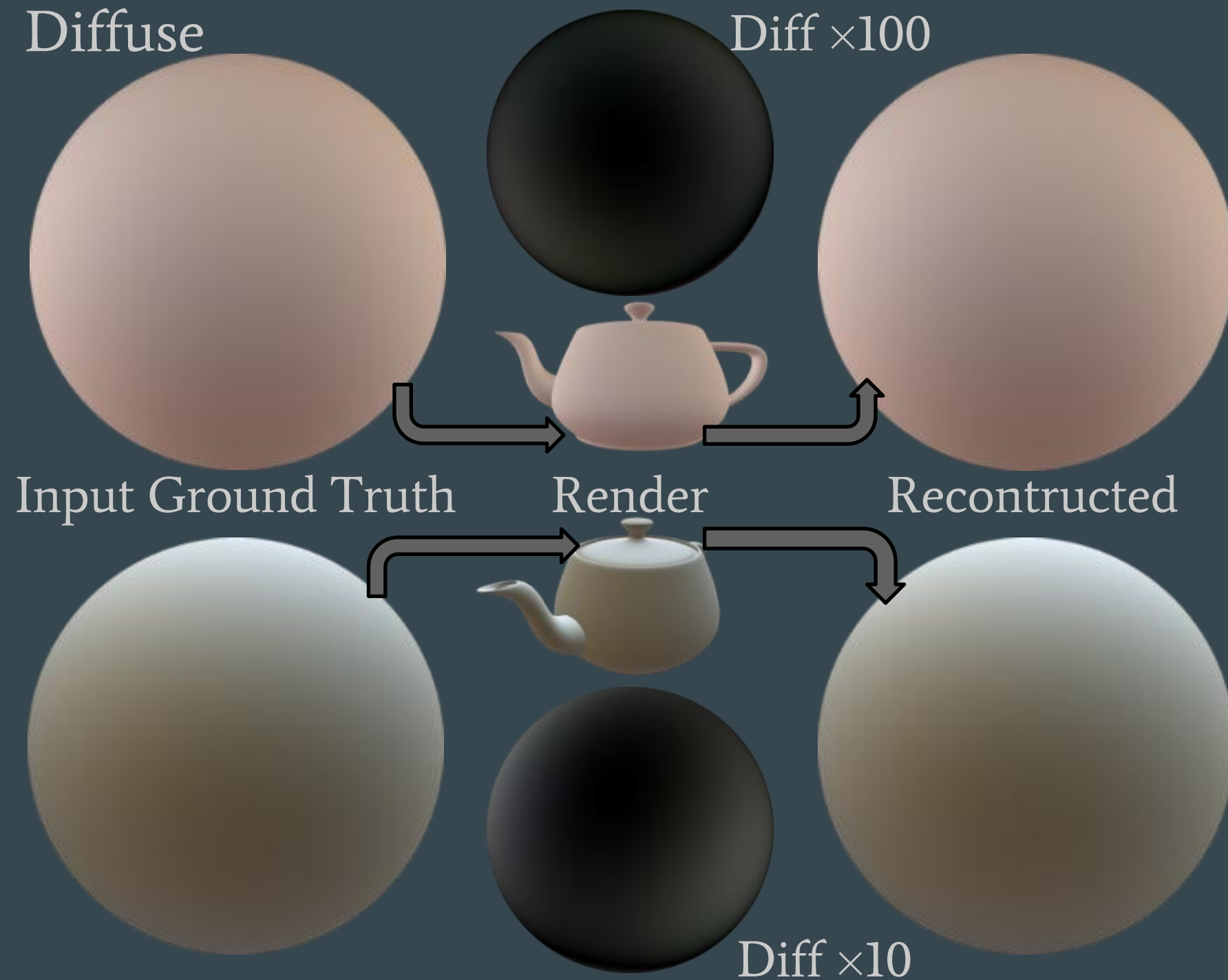
1st Hole Filling
Harmonic interpolation
on tessellated sphere



2nd Regularize
Slightly blur discontinues
of disconnected polygons

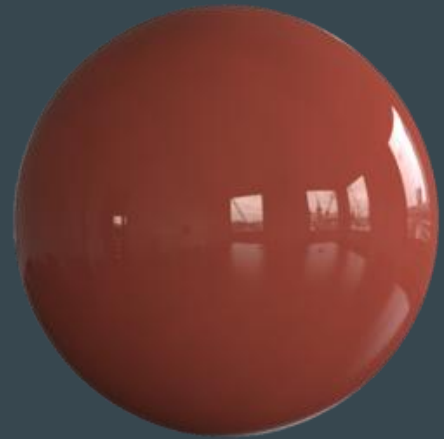


Reconstruction Validation



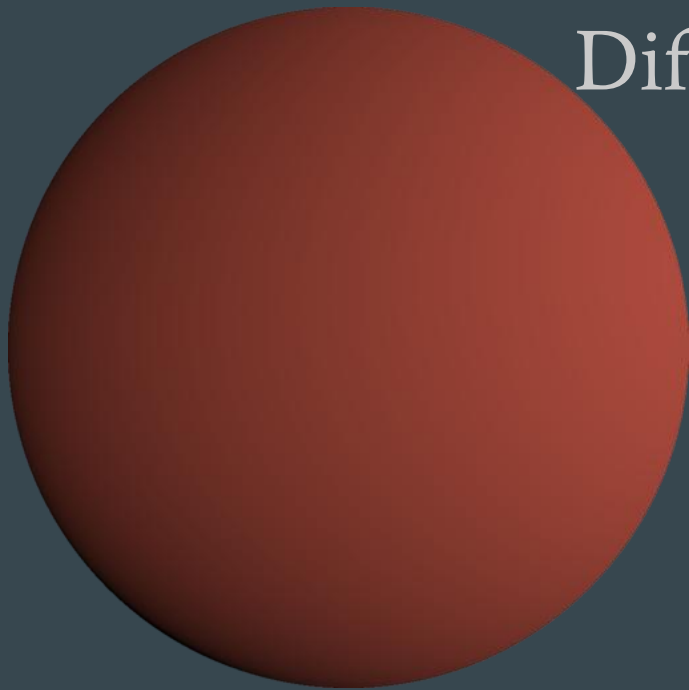
Reconstruction Validation

Sphere in
perspective



Shading

Diffuse



Head



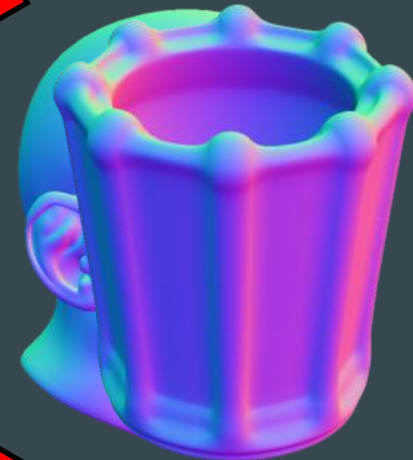
Shading



Normals



Reflection

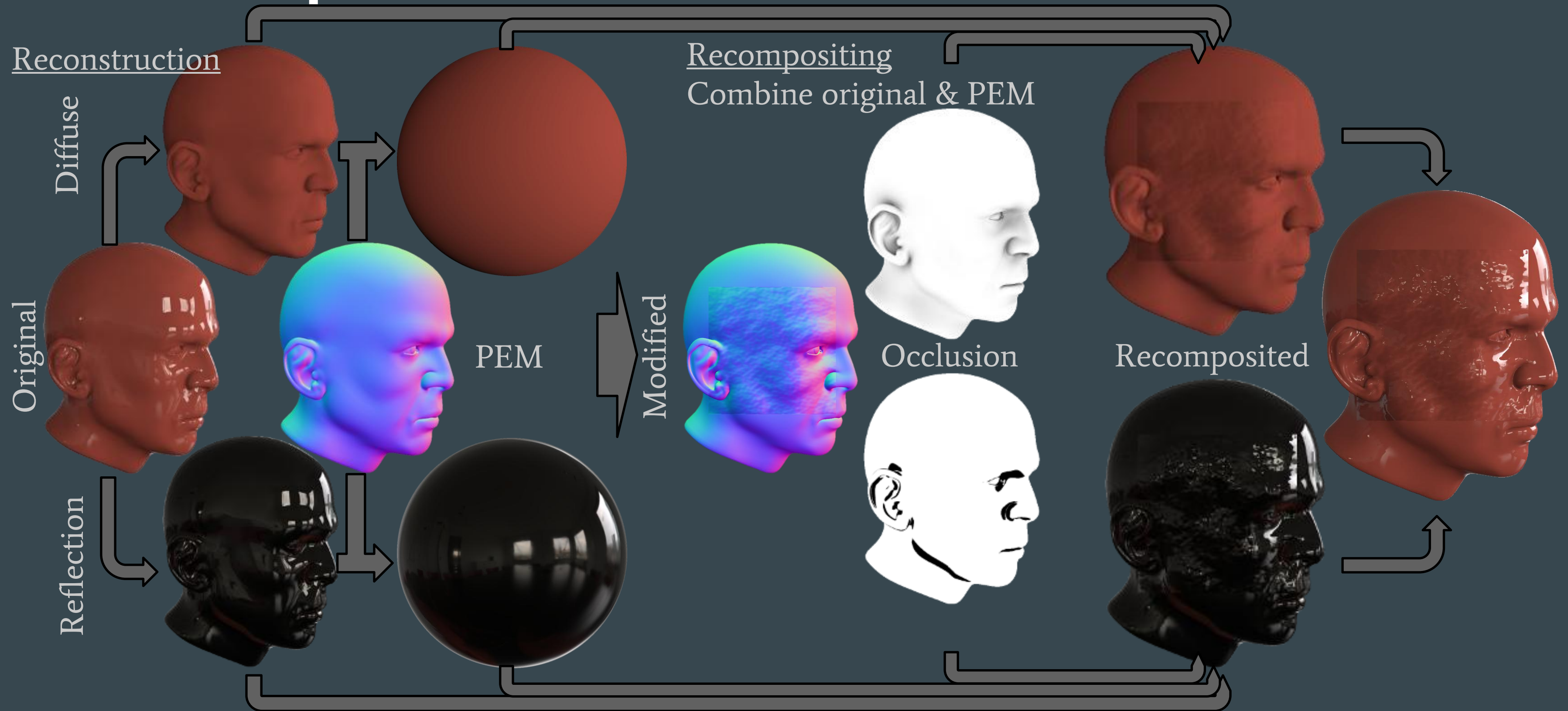


Normals

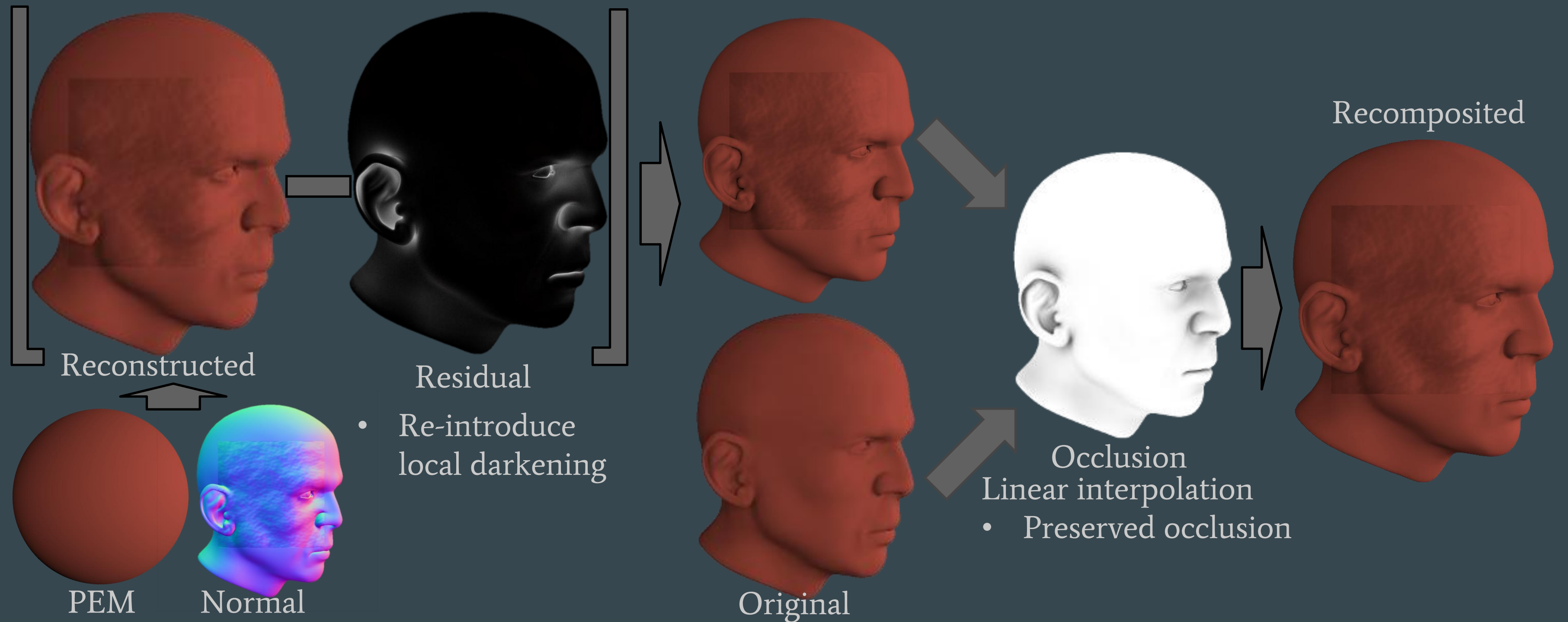


Re-compositing

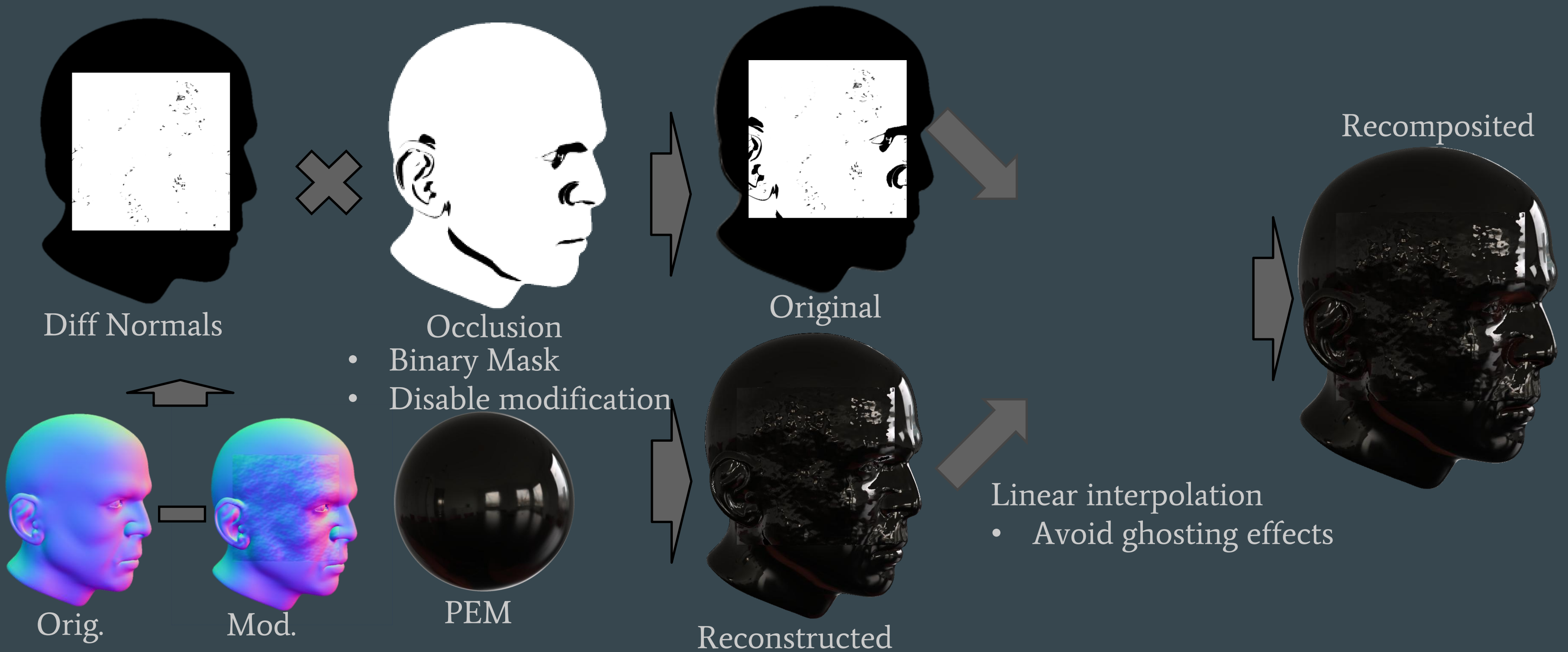
General Pipeline



Diffuse pipeline



Reflections pipeline



Recap

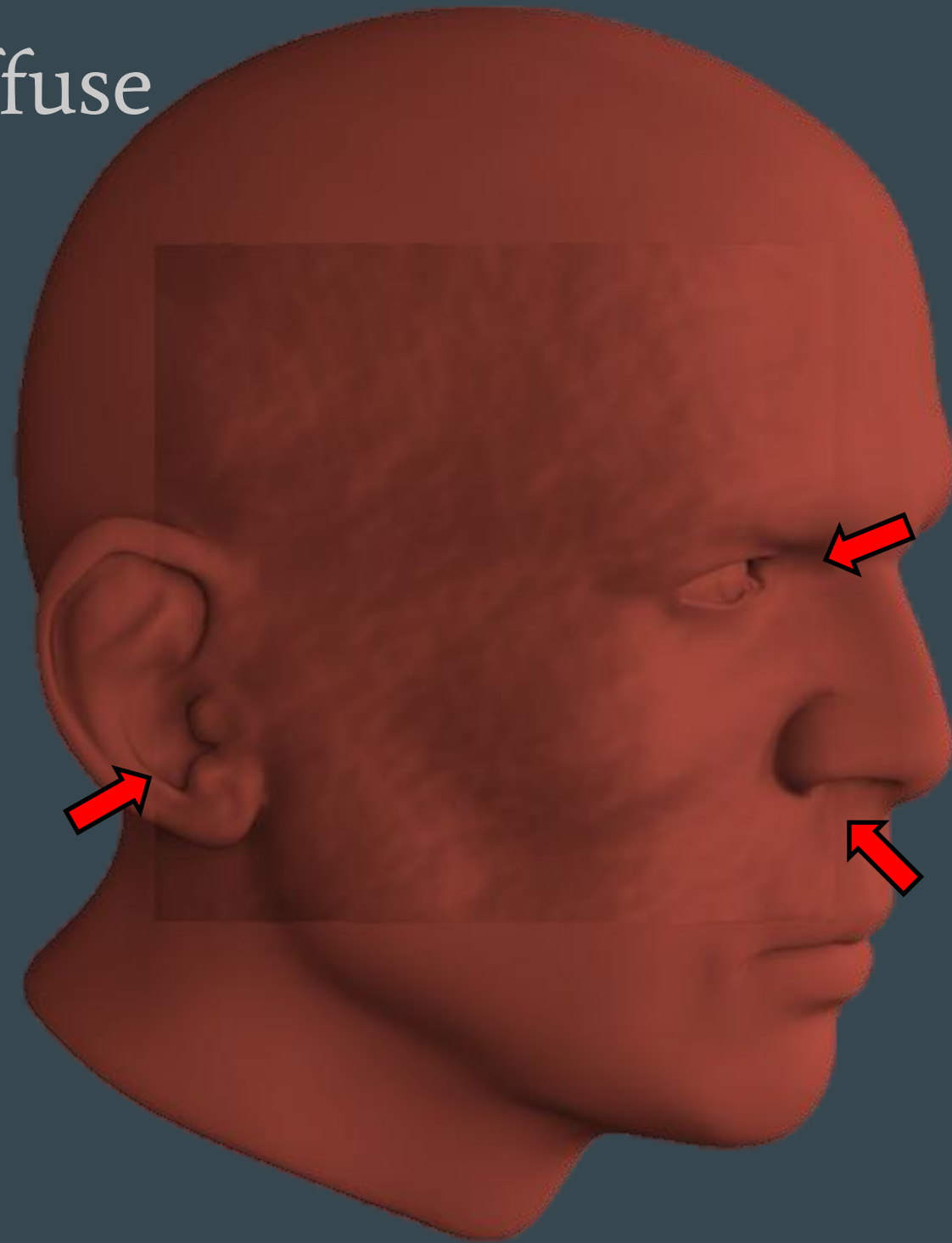


Diffuse

Add residuals



Interpolate
using occlusion



Reflections



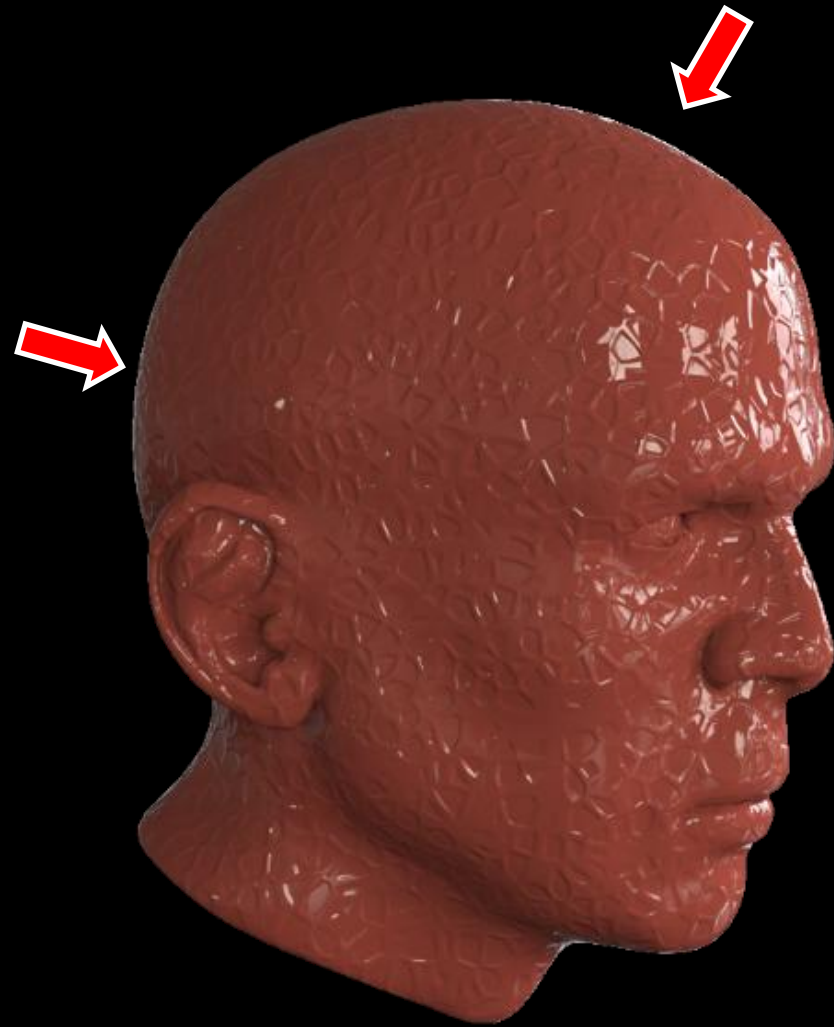
Interpolation

Results

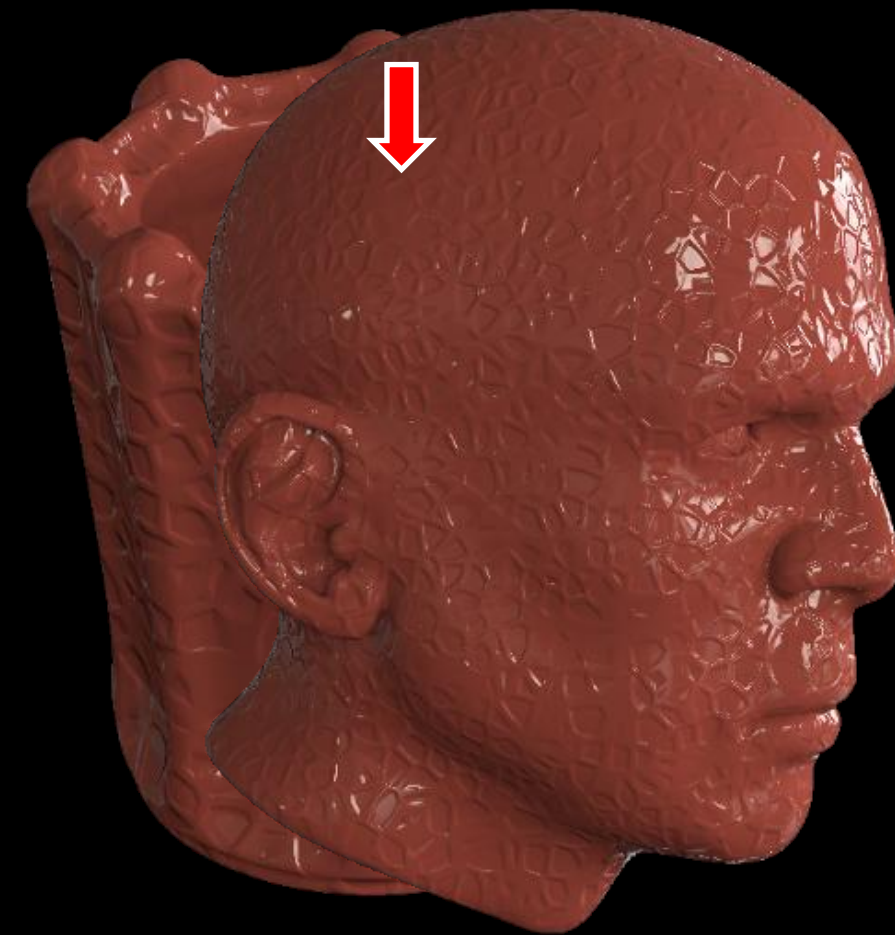


Normal Modification Comparison

Ours



Ground Truth



Ours



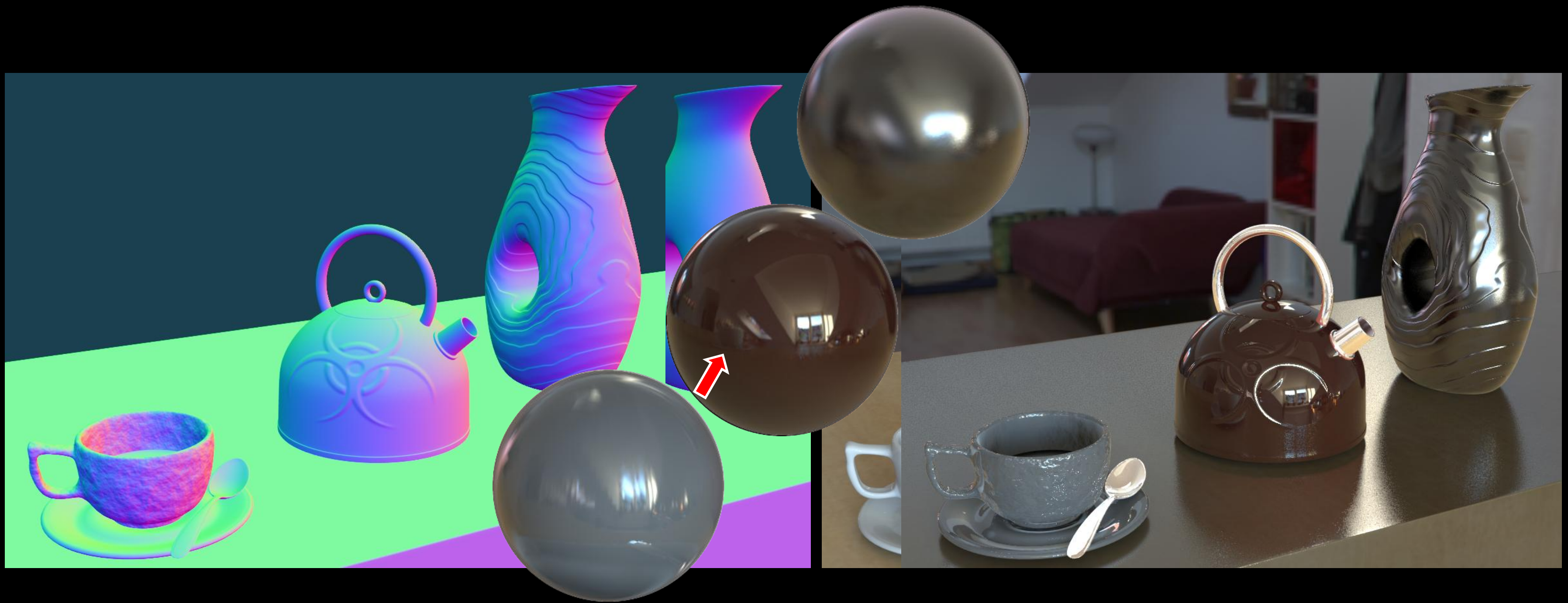
Ground Truth







Complex Scene Reconstruction





Timings (ms)

Model	Diffuse Reconstruction	Reflection Reconstruction	
		Partial Reconstruction	Hole filling
Red Sphere	110	315	215
Red Head	184	470	280
Red Vase	147	385	192
Cup	29	45	325
Kettle	65	97	650
Black Vase	64	133	4000
Truck Body	119	120	6000
Front Mudguard	25	45	2500
Rear Mudguard	14	26	3700

Conclusions

Plausible pre-filtered env. maps are sufficient to modify local shape at the compositing stage

Limitations

Restricted to opaque objects

Limited by the geometric complexity

Normal mapping, not displacement

Future Work

Extension to spatially-varying reflectance

Output more info at the rendering stage

Combine with manipulation of materials

Thank you



prism

<http://prism-network.eu/>

GRATIN



<http://gratin.gforge.inria.fr/>



<https://www.thefoundry.co.uk/>

Complex Scenes Input

