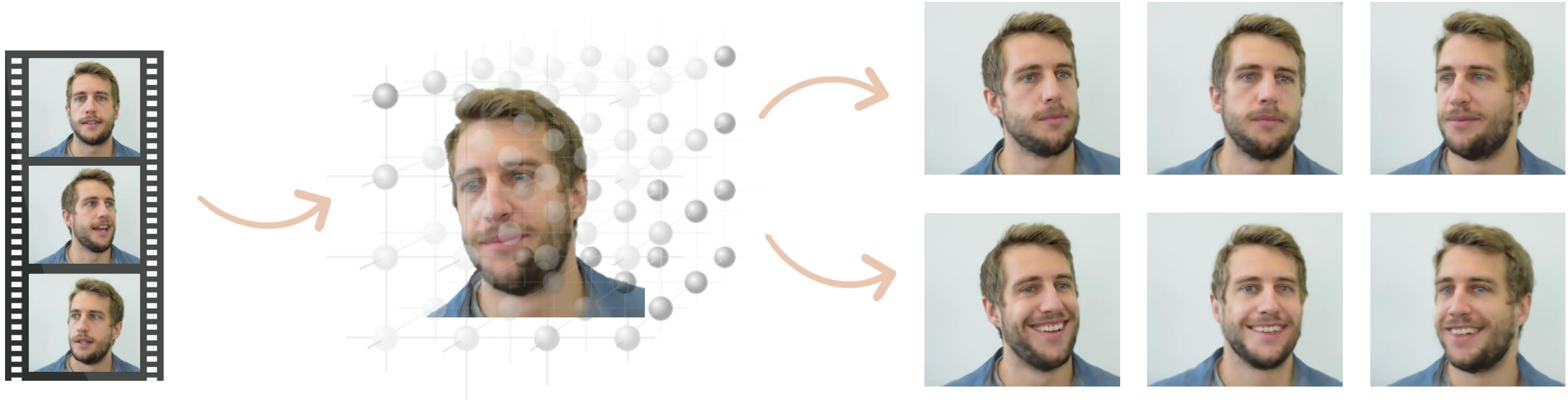


The Revolution of Neural Rendering

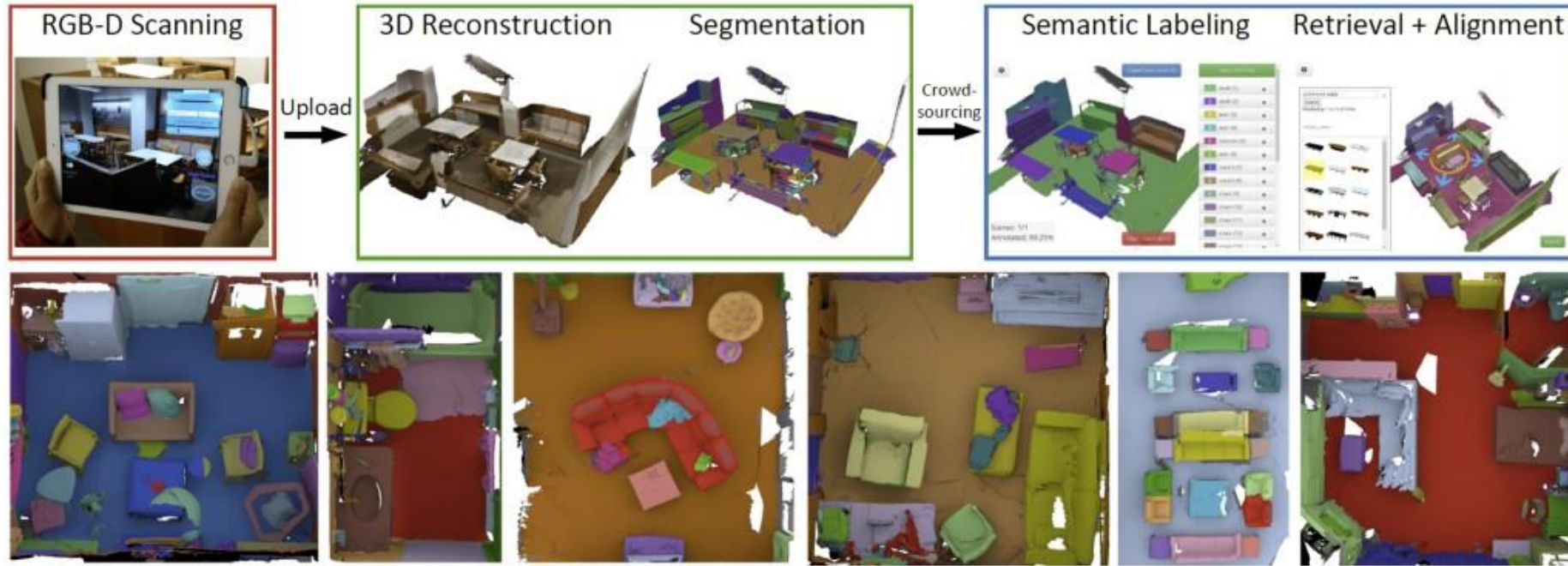


Visual Computing Group

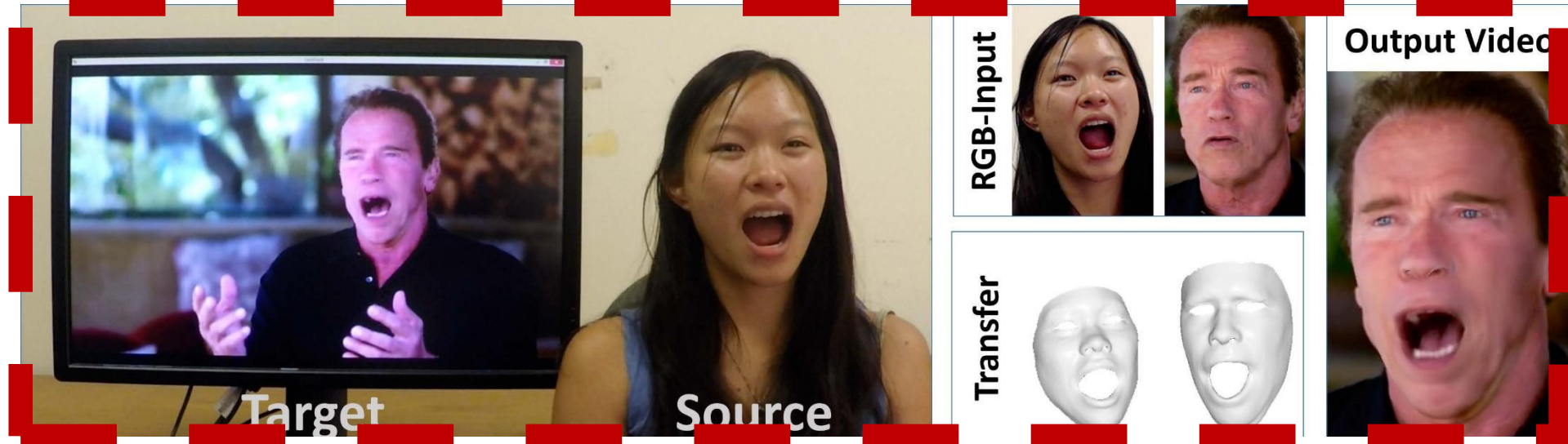
Prof. Matthias Nießner

Visual Computing & AI Group

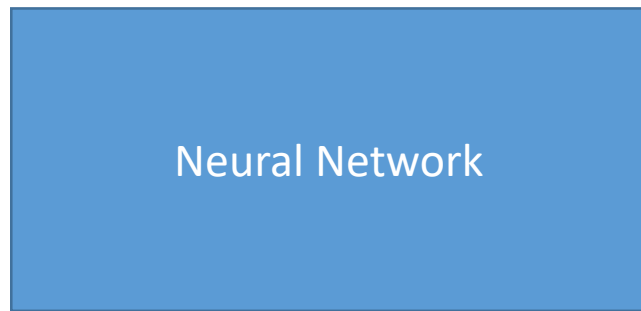
3D Reconstruction & Scene Understanding



AI-Driven Video Synthesis & Editing



What is Neural Rendering?



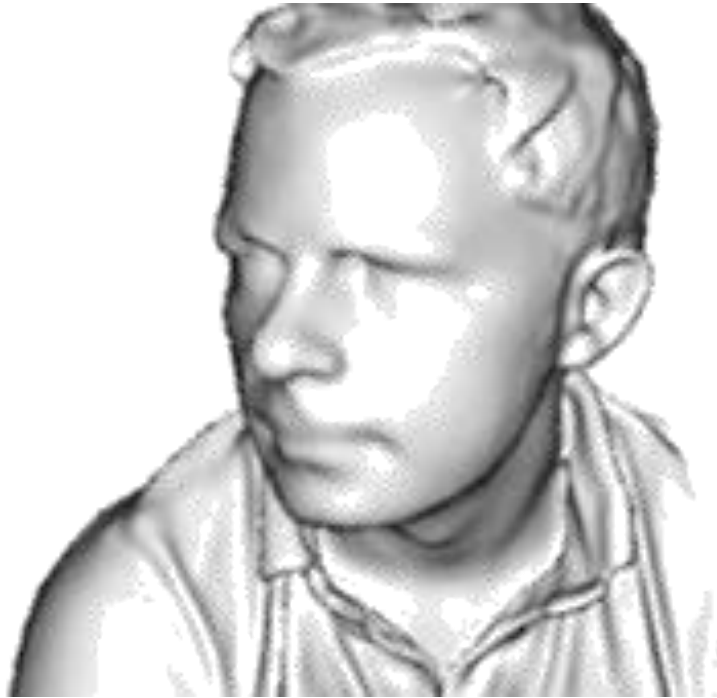
Why Neural Rendering?

Capture the World

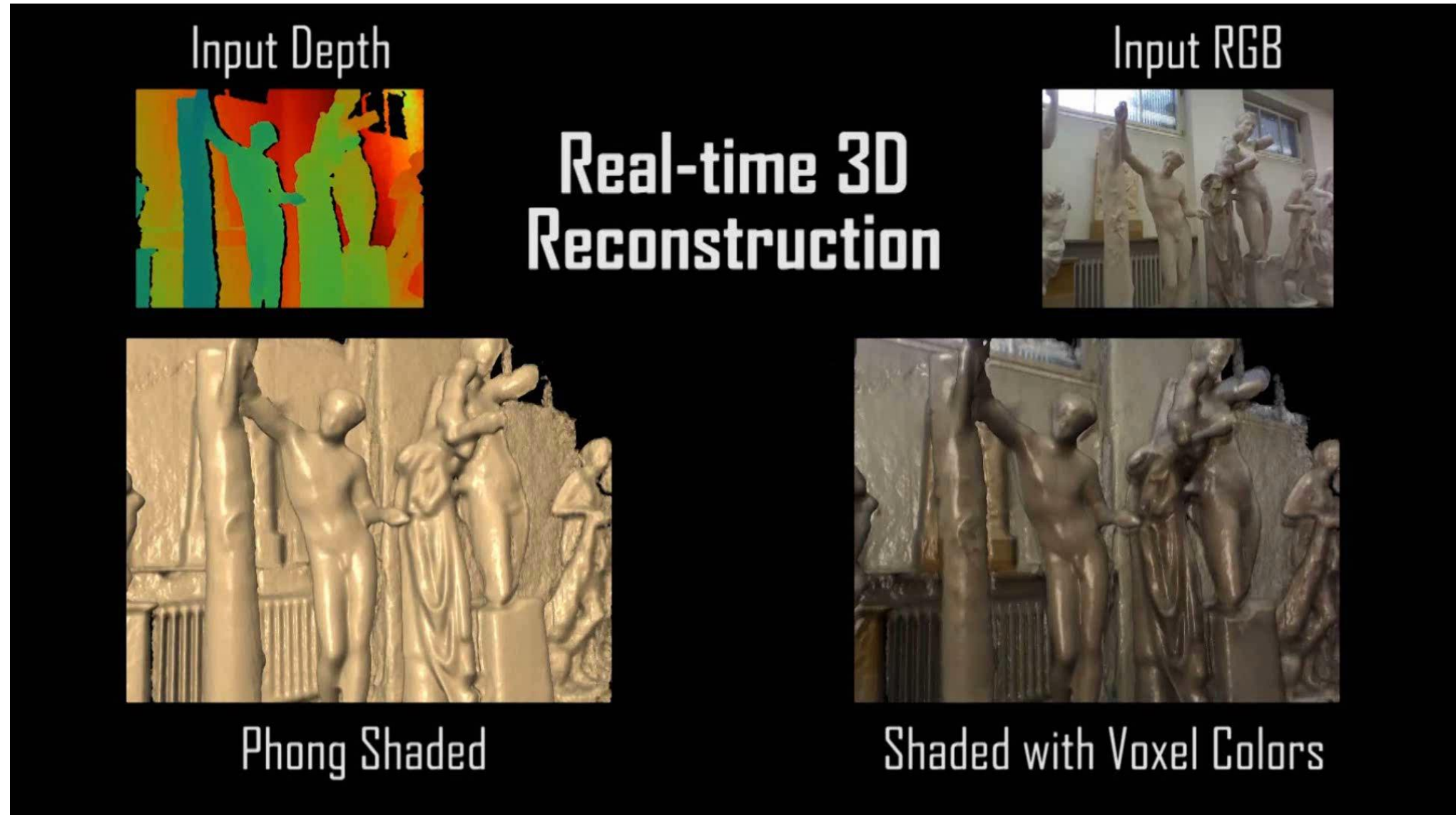


Photo-realistic Reconstruction

3D Reconstruction



3D Reconstruction



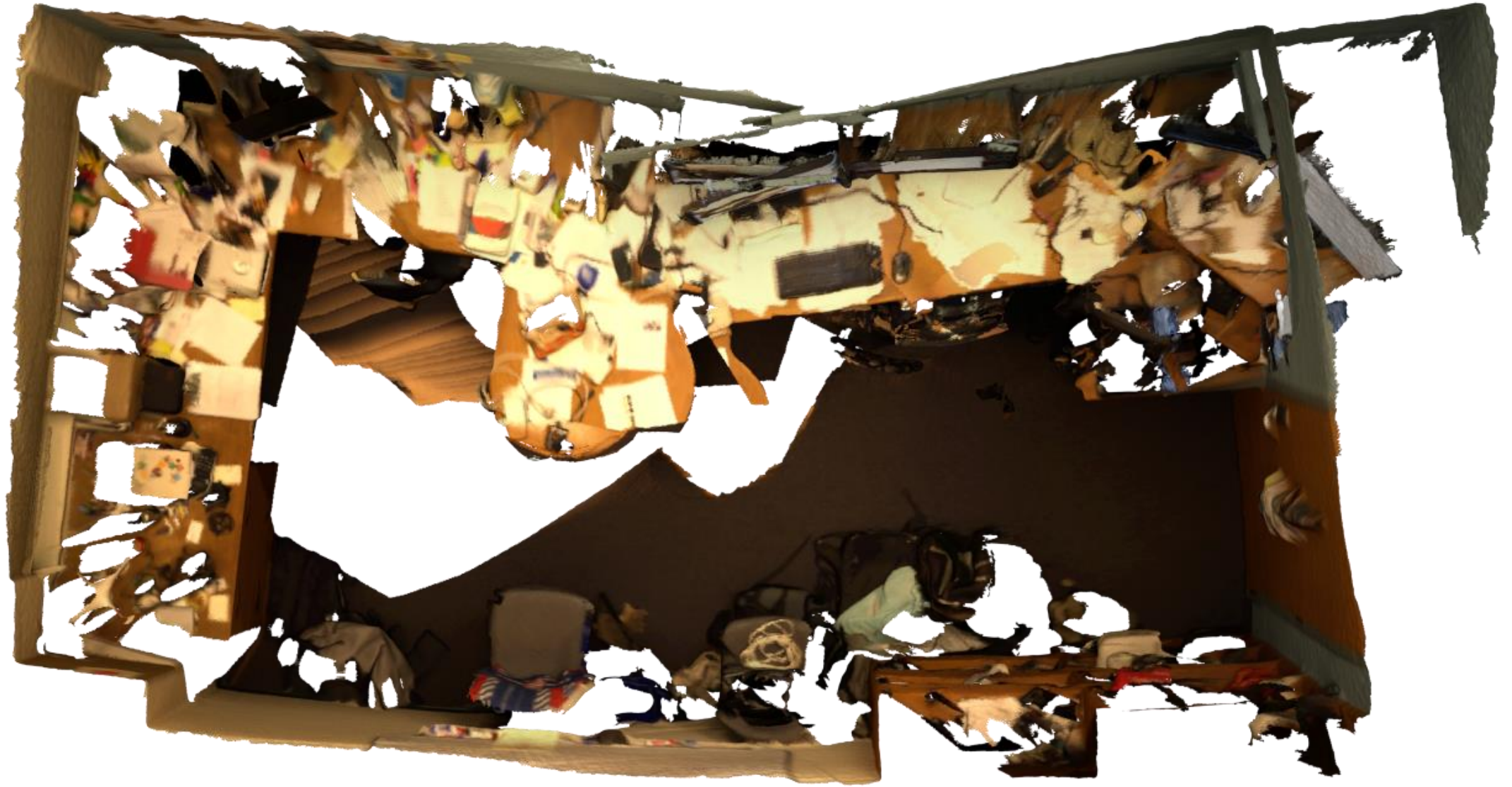
3D Reconstruction



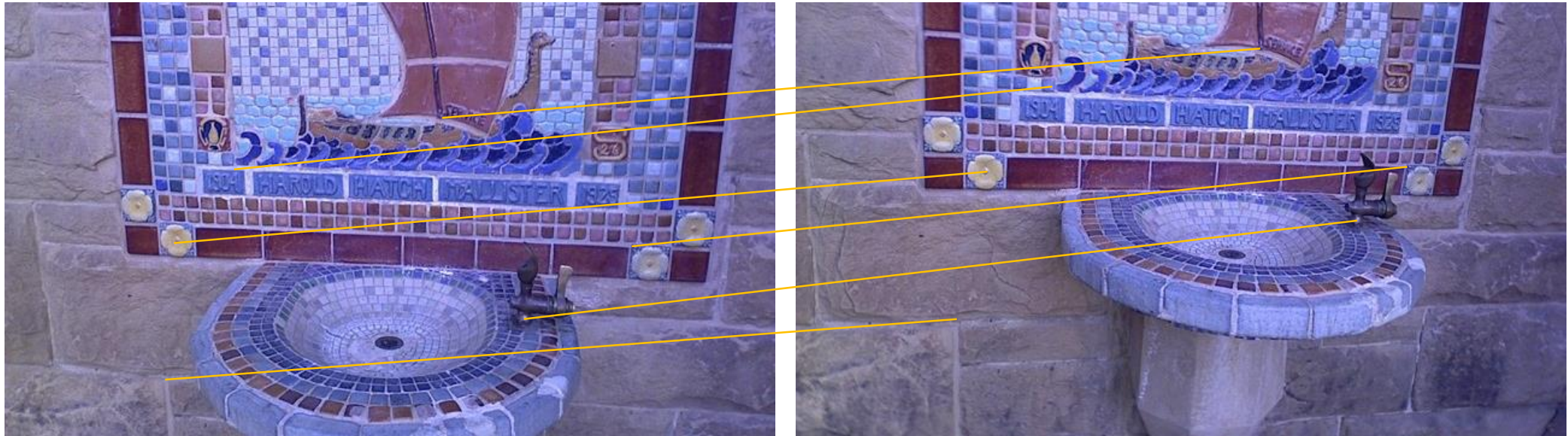
3D Reconstruction



Loop Closure

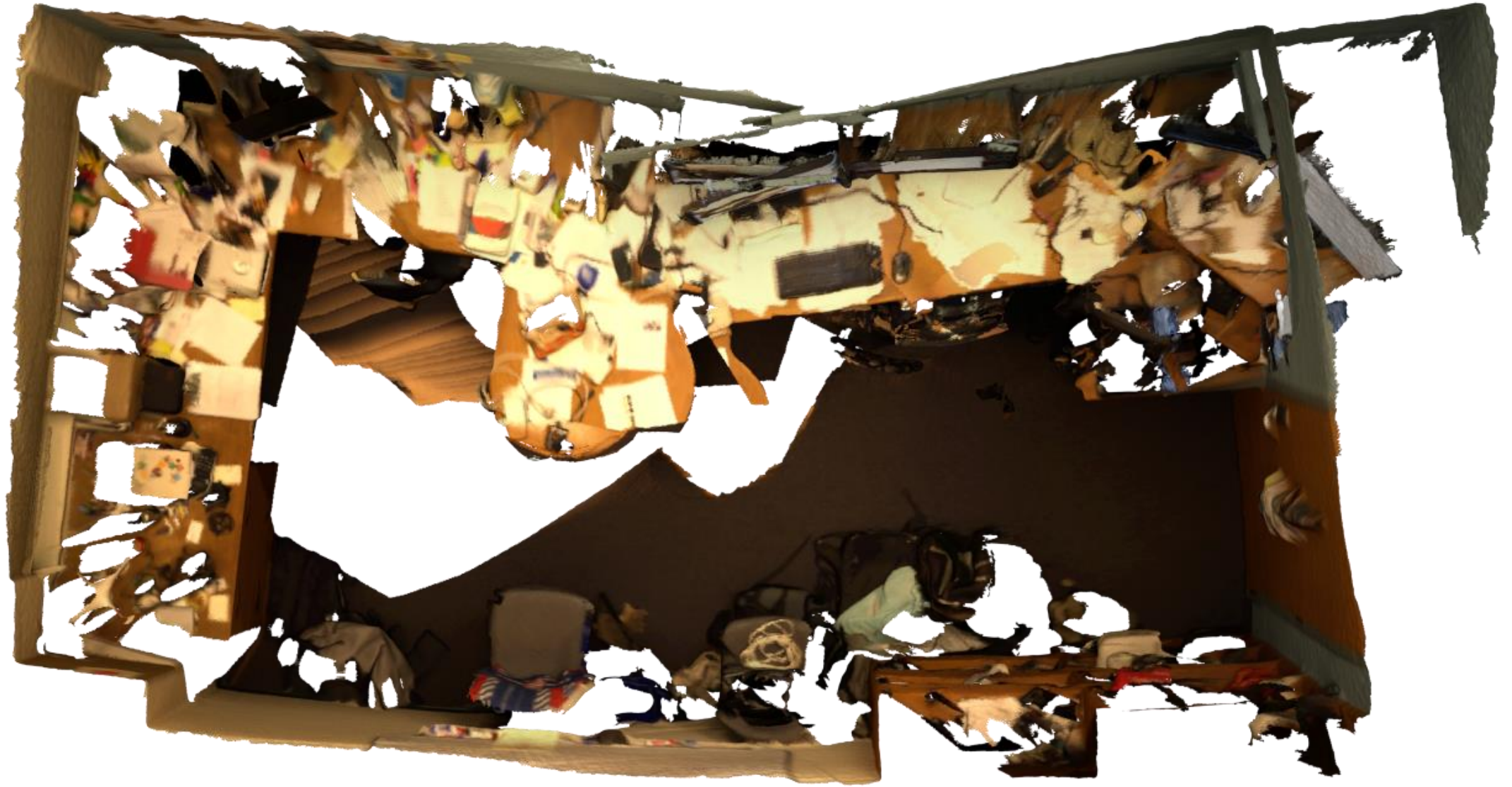


3D Reconstruction: Real-time Bundling



$$E_{bundle}(T) = \sum_{i,j}^{\#frames} \sum_k^{\#corresp.} \|T_i p_{ik} - T_j p_{jk}\|_2^2$$

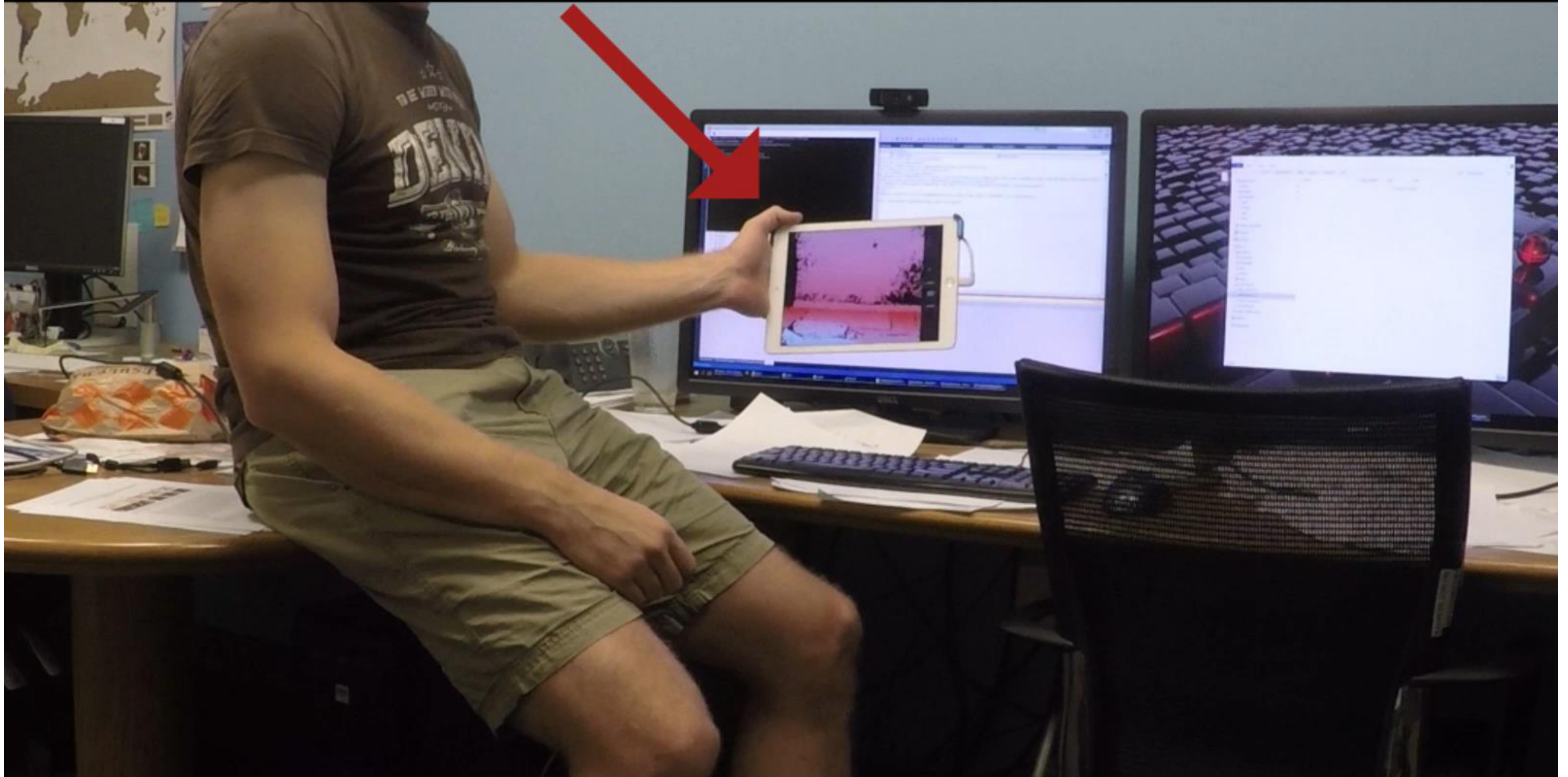
Loop Closure



3D Reconstruction: Real-time Bundling



Streaming RGB-D Sensor



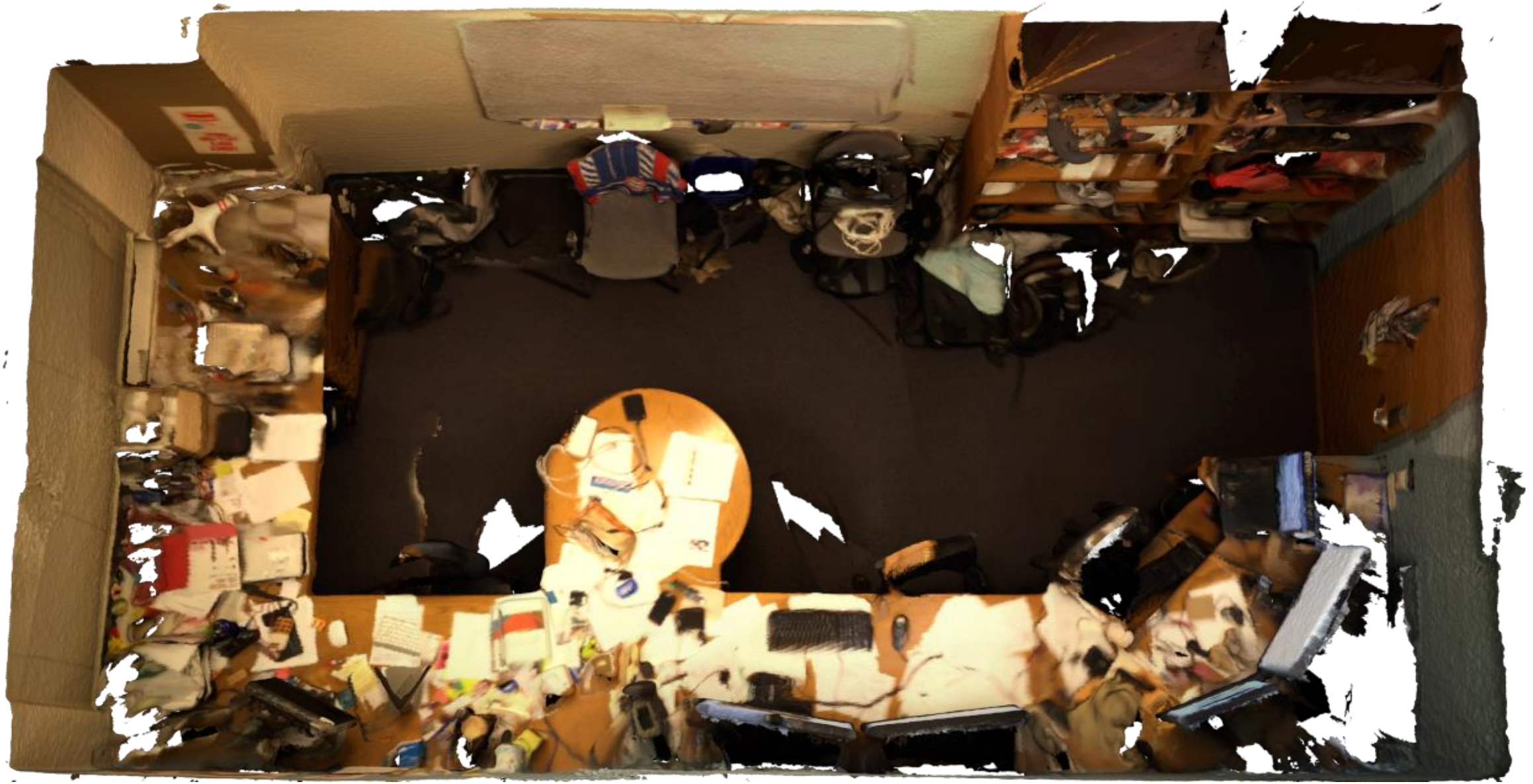
Real-time 3D Reconstruction



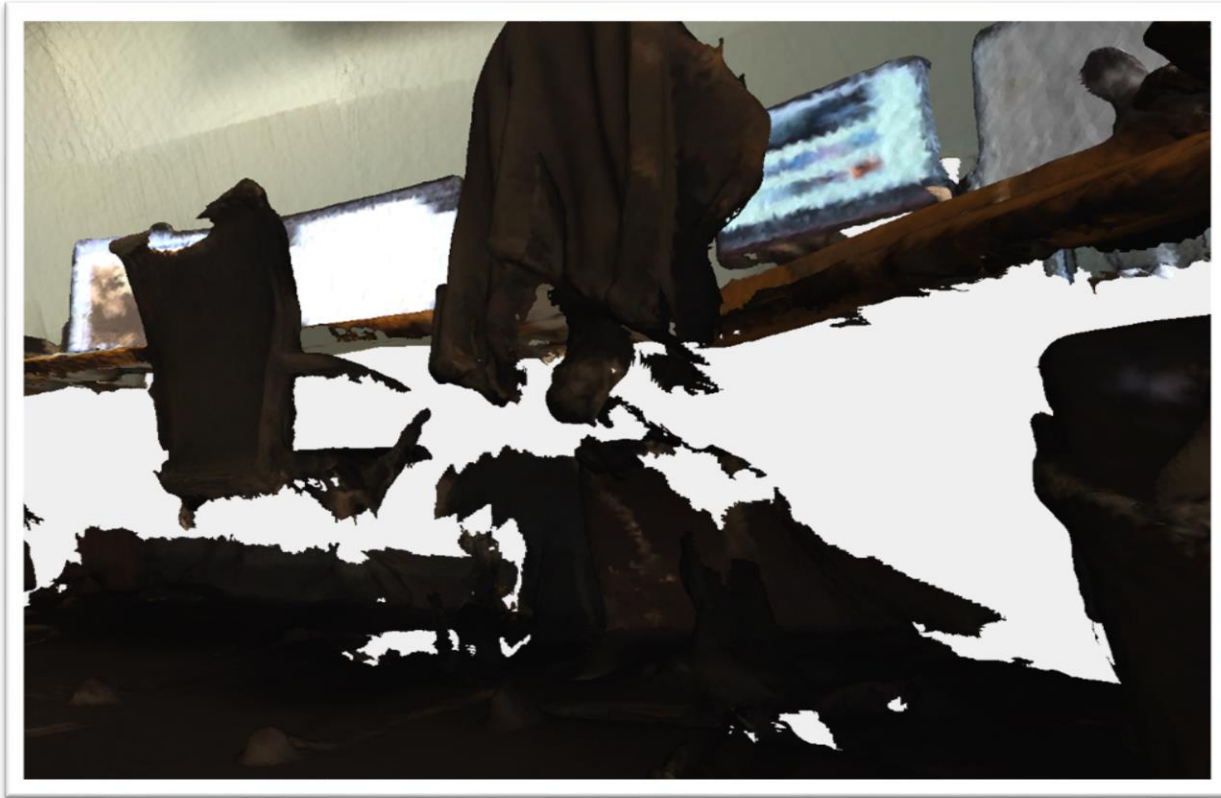
Real-time 3D Reconstruction



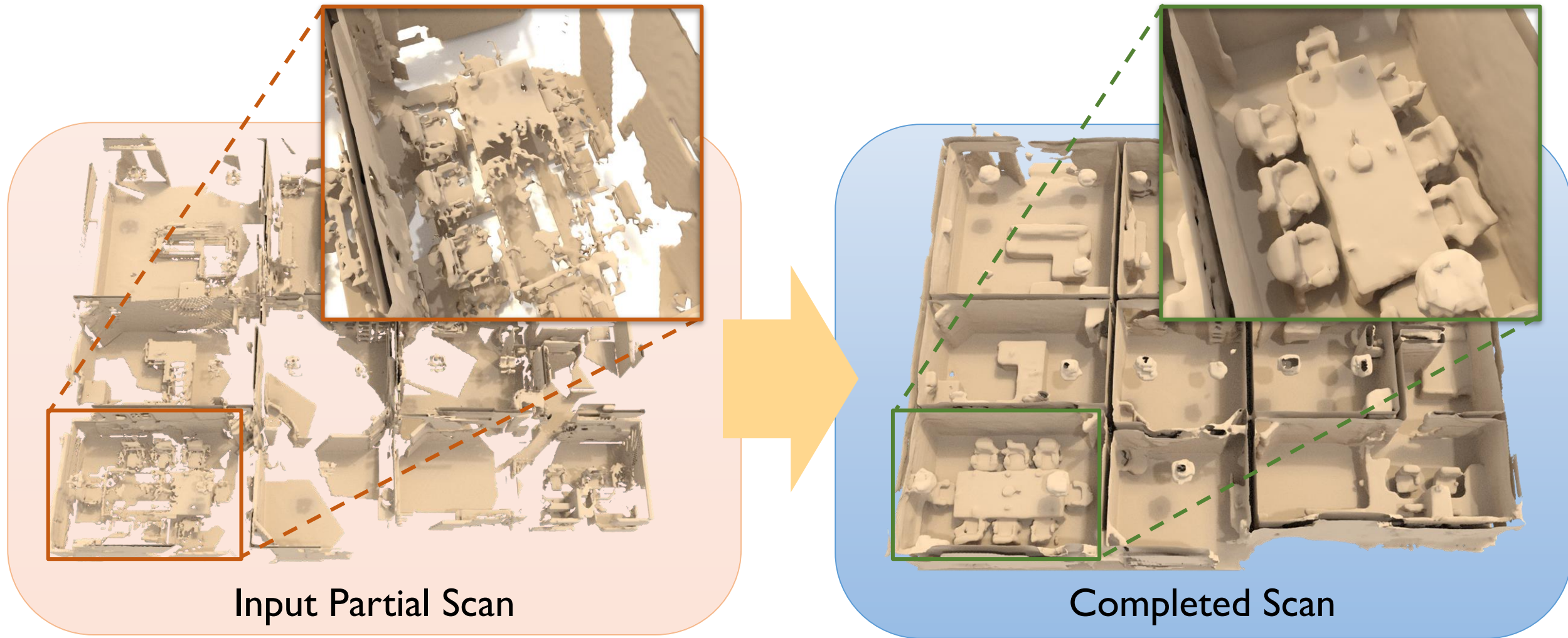
3D Reconstructions



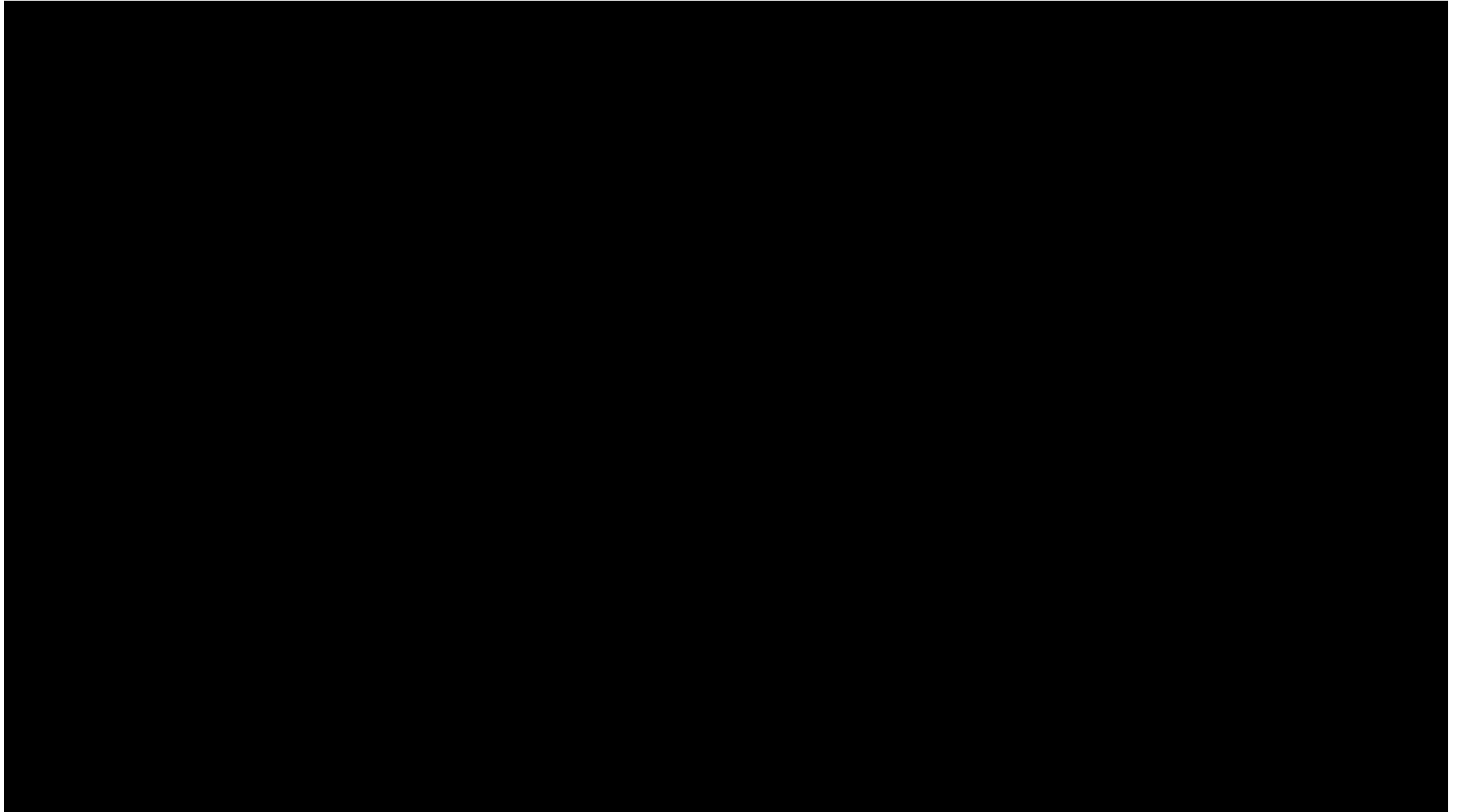
Incomplete Scan Geometry



ScanComplete

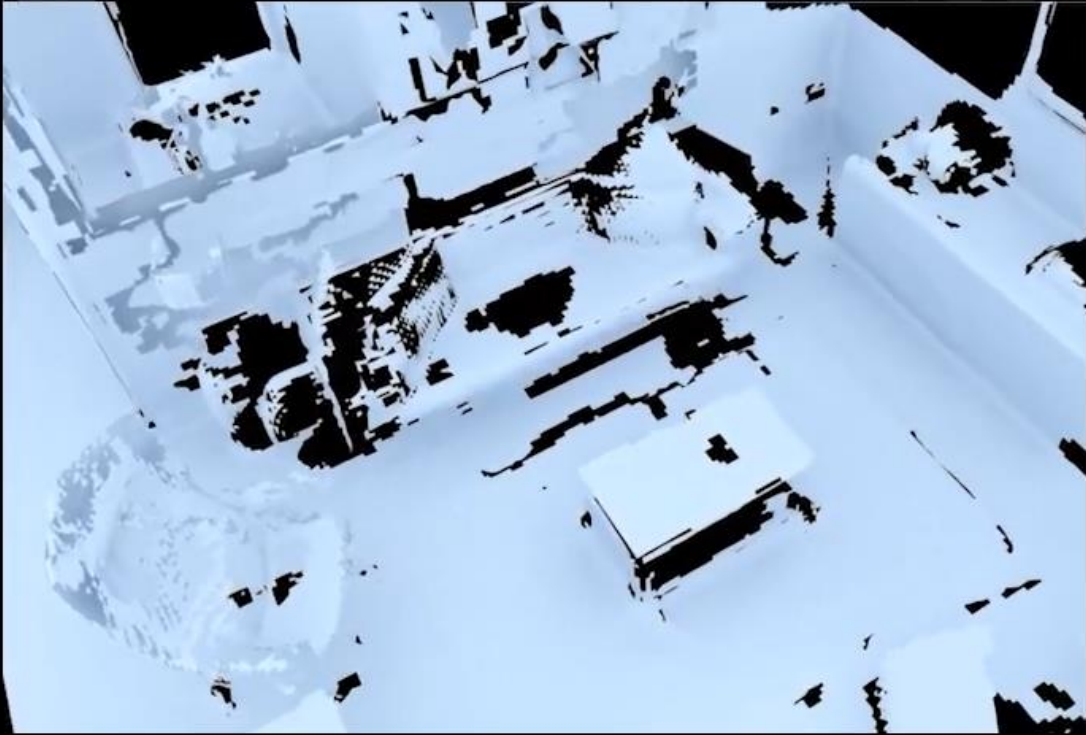


ScanComplete

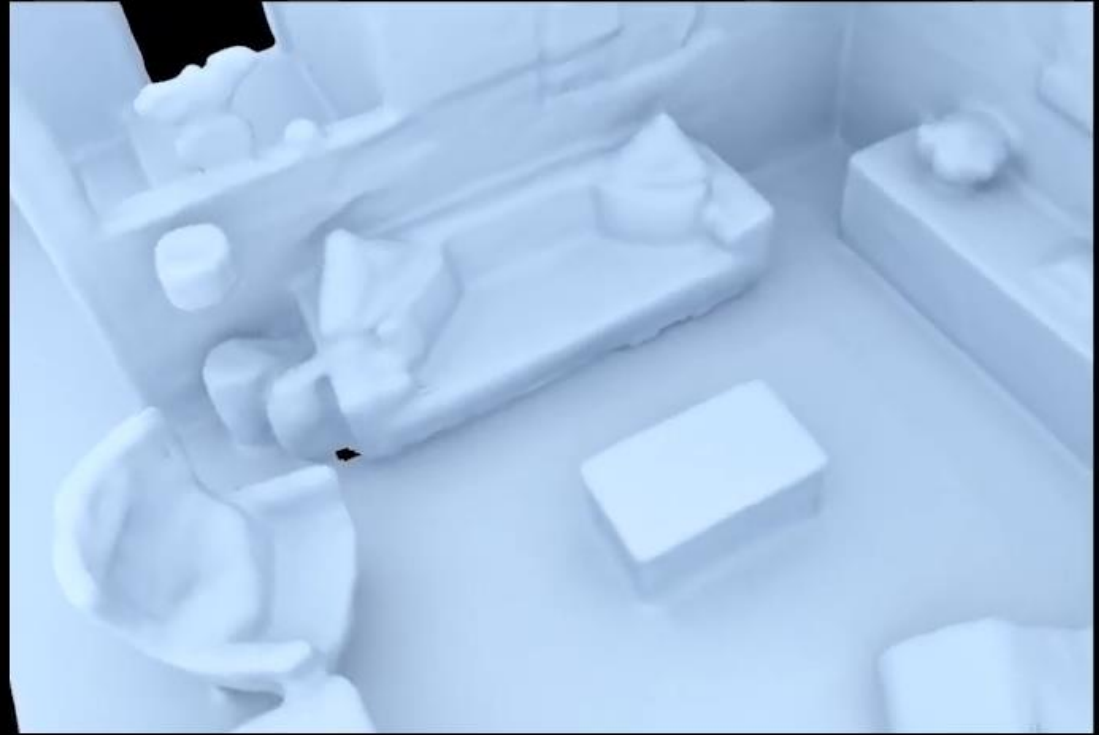


SG-NN: Sparse Convs + Self-Supervised

Input Scan



SG-NN (Ours)



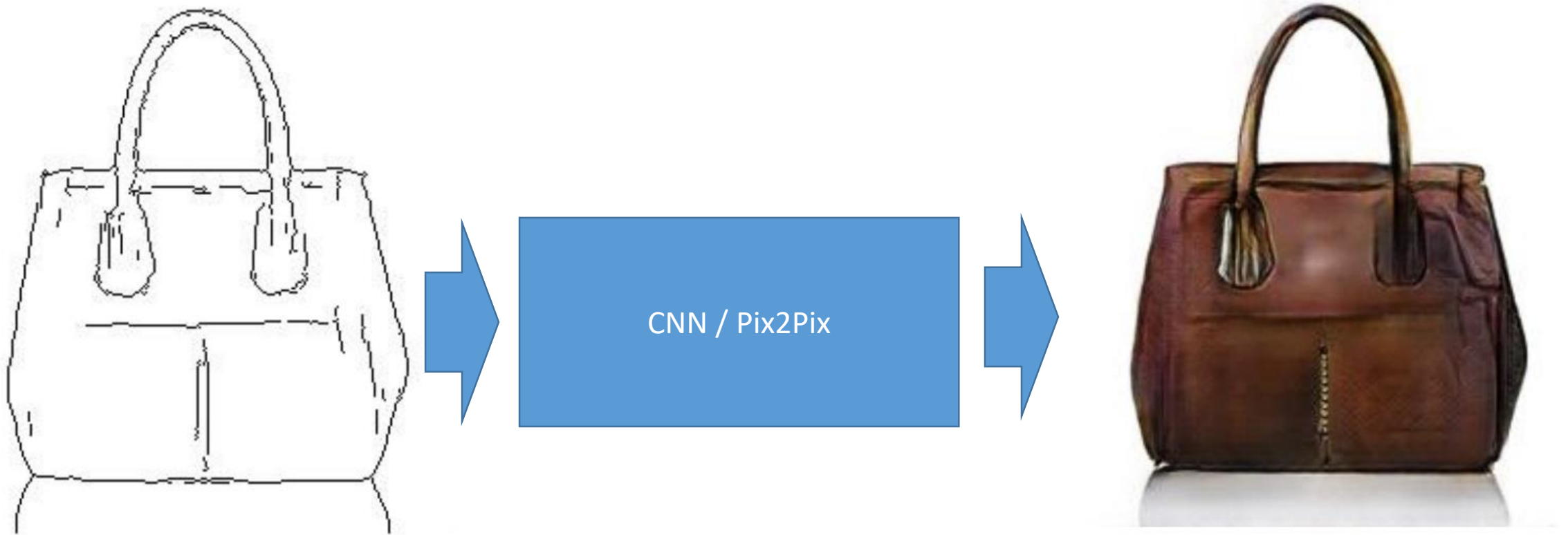
Still no realistic textures / appearance (yet)



If we can't fix reconstruction, why not change rendering?

Conditional GANs for Neural Rendering

Conditional GANs for Neural Rendering



Conditional GANs for Neural Rendering



CNN / Pix2Pix



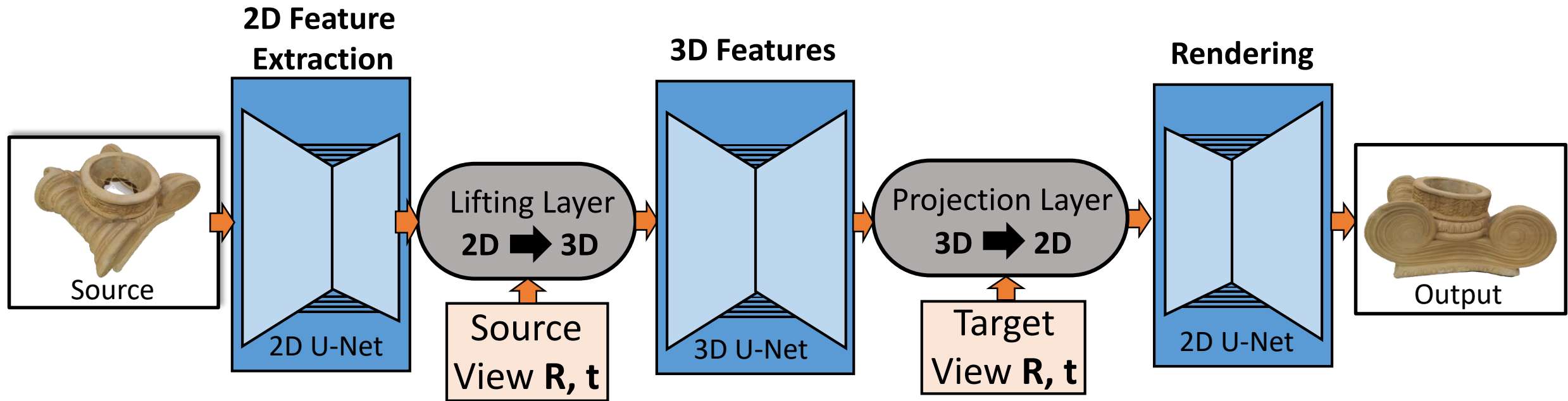
Fix rendered images?

Videos still challenging for cGANs...

Pix2Pix [Isola et al. 2017]



DeepVoxels: Explicit 3D Features



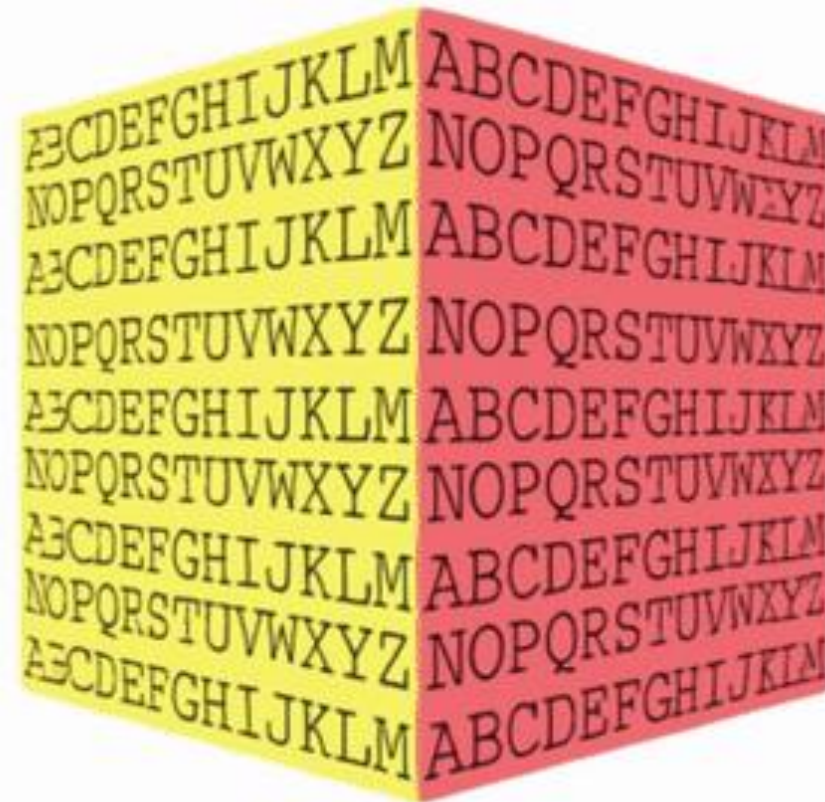
Simplified overview for novel view synthesis

DeepVoxels: Explicit 3D Features

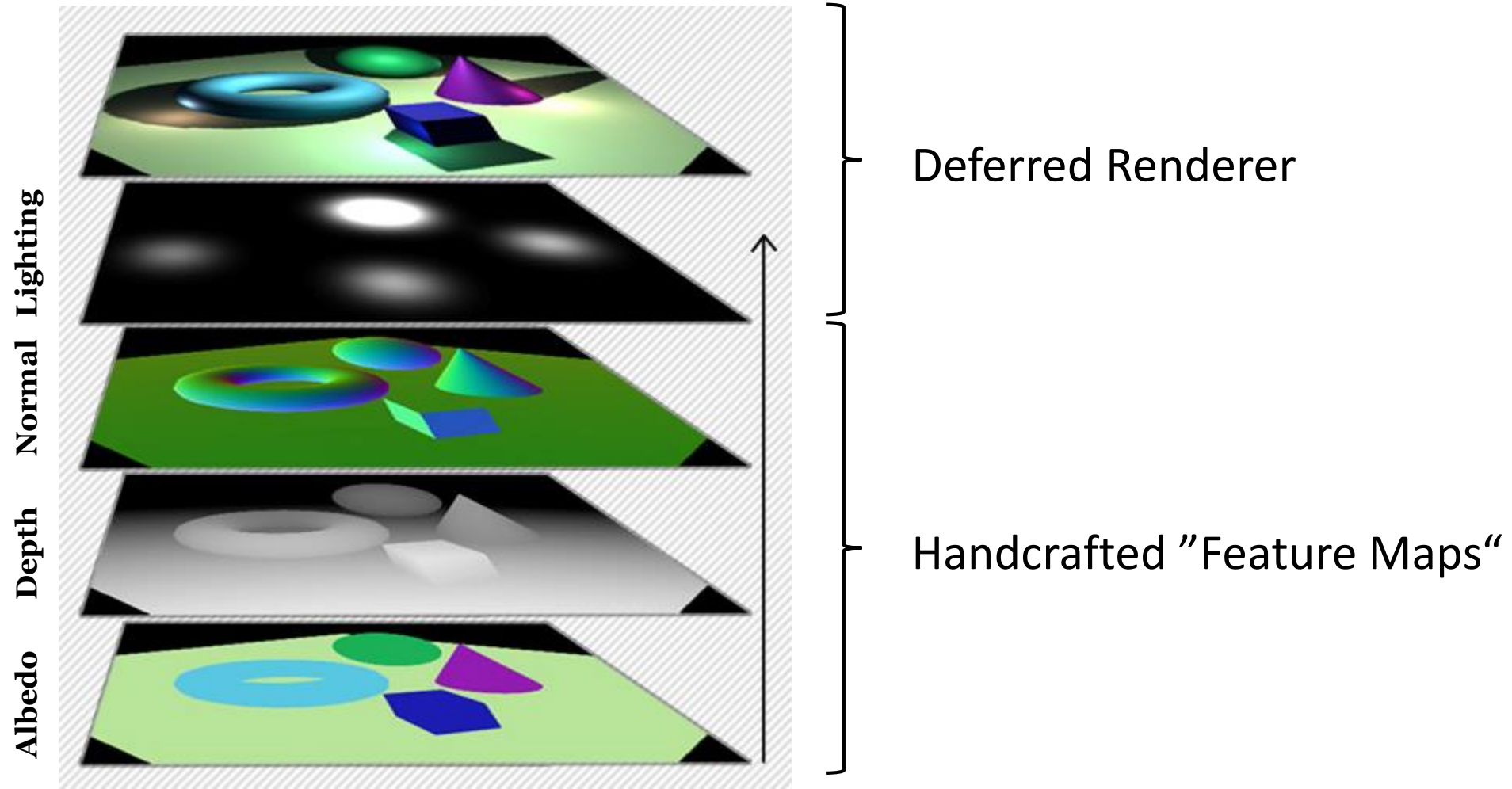
Pix2Pix [Isola et al. 2017]



DeepVoxels (Ours)

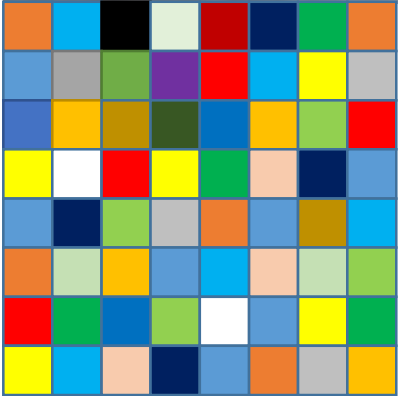


Deferred Rendering



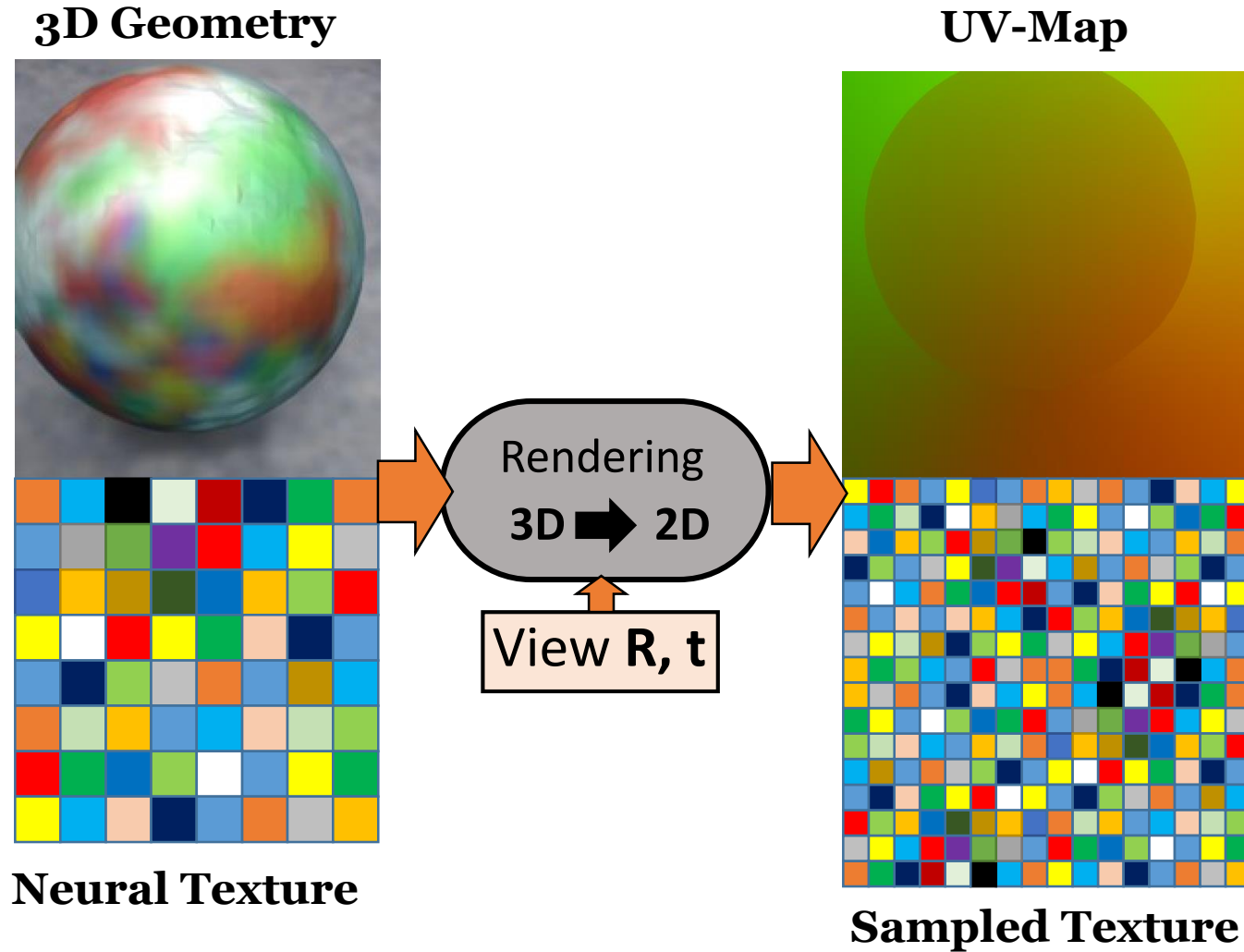
Neural Textures: Features on 3D Mesh

3D Geometry

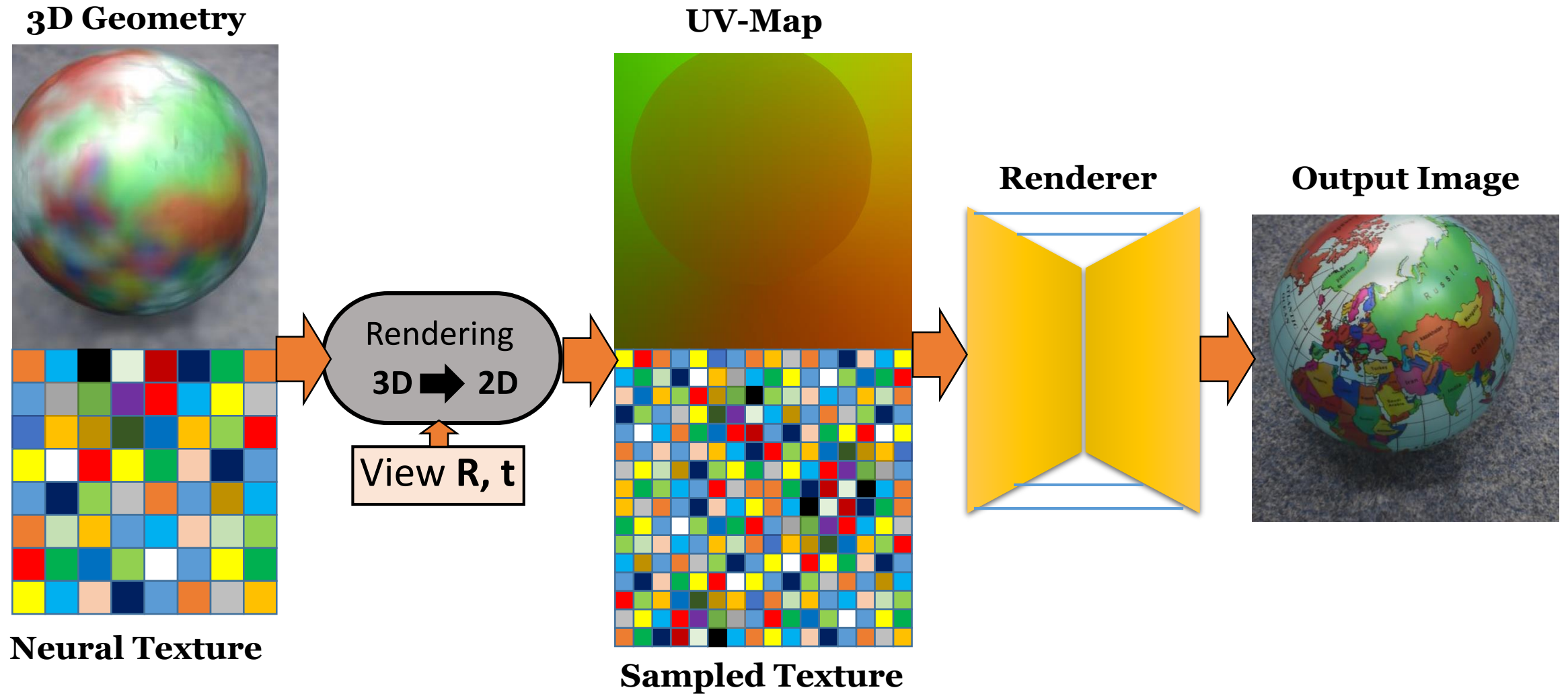


Neural Texture

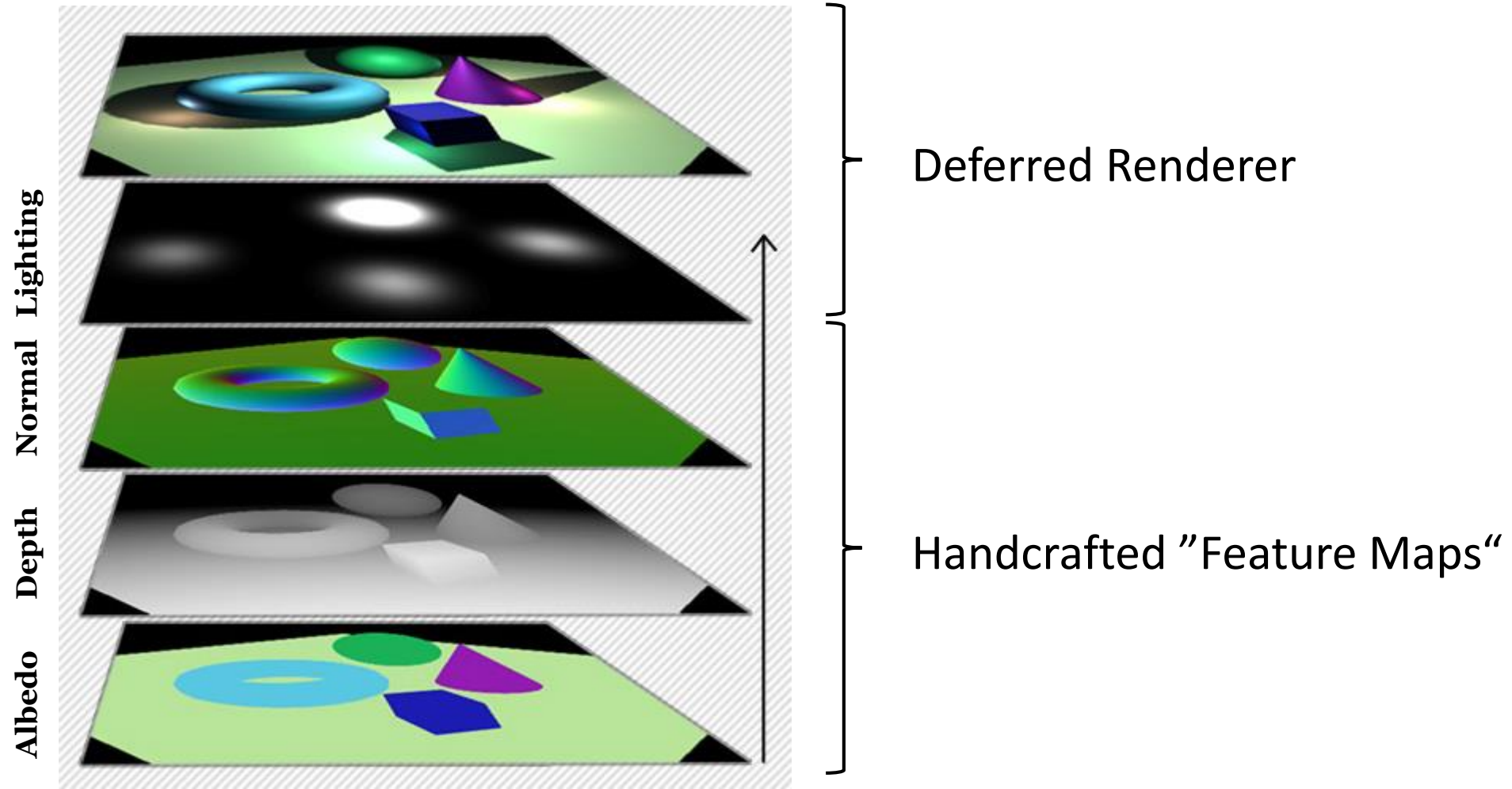
Neural Textures: Features on 3D Mesh



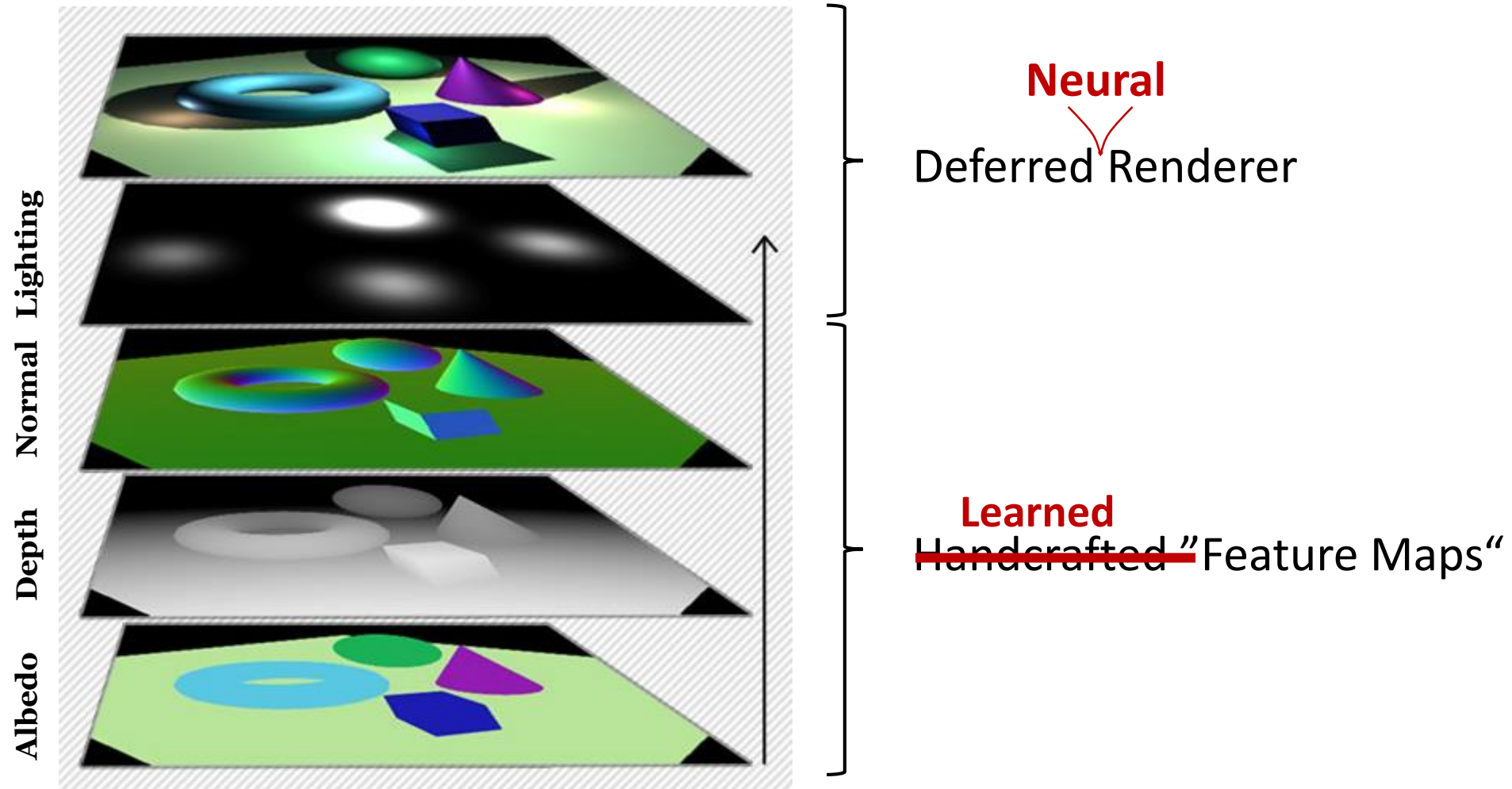
Neural Textures: Features on 3D Mesh



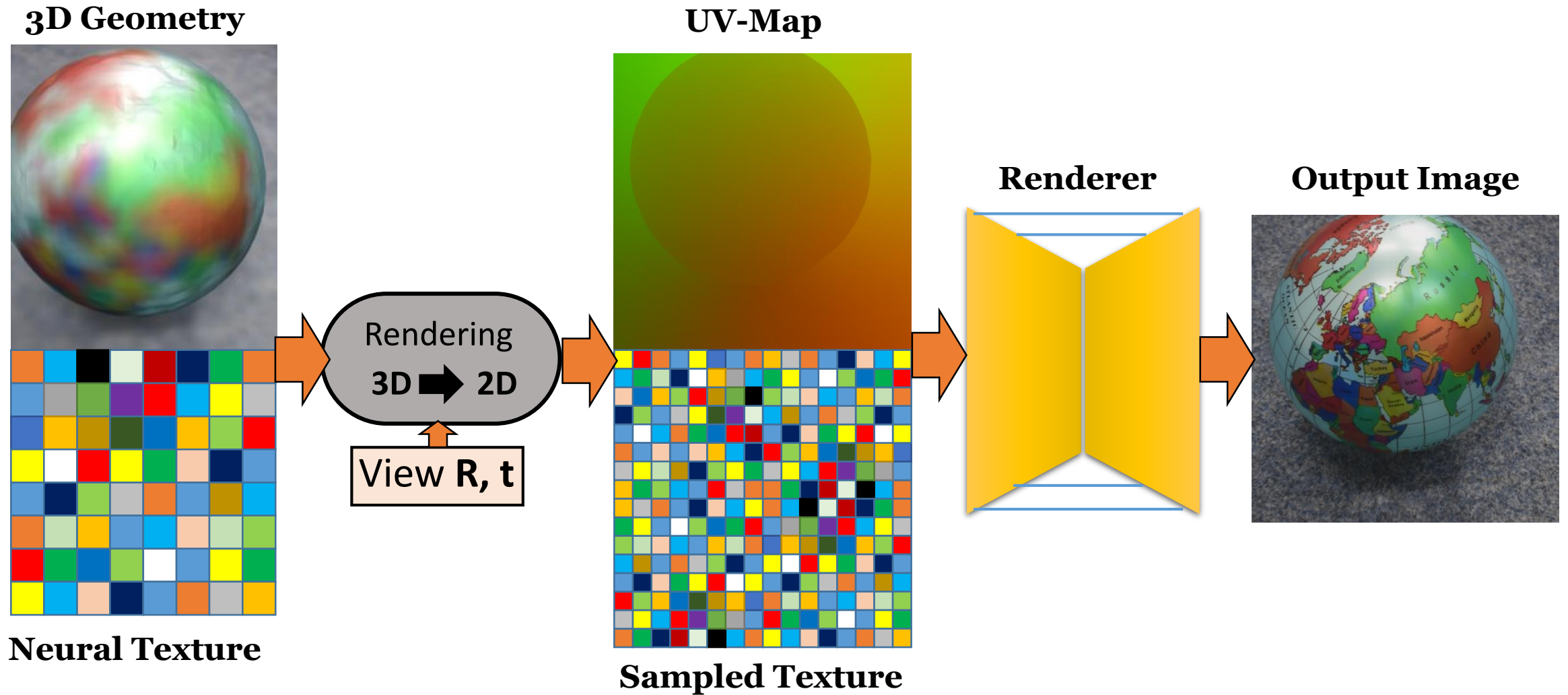
Deferred Rendering



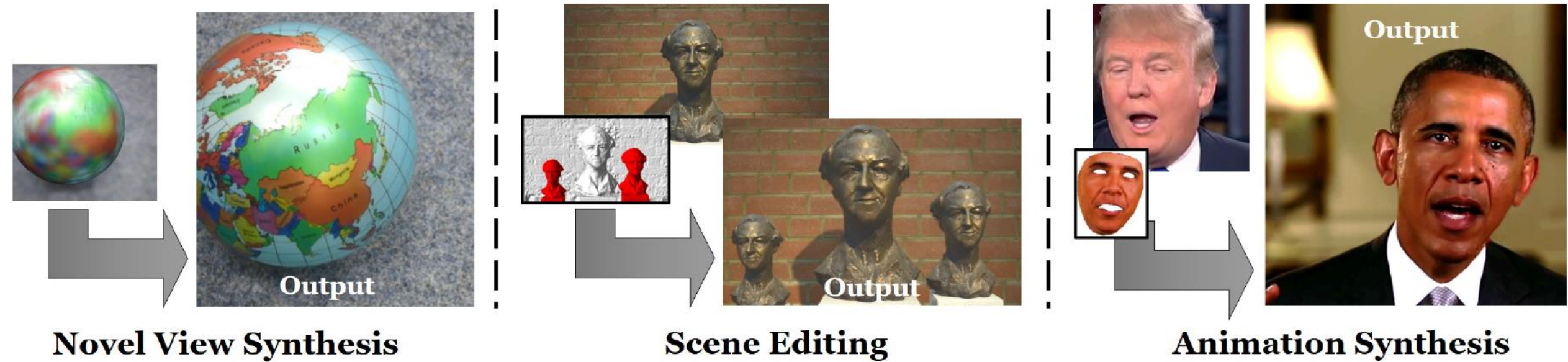
Deferred Neural Rendering



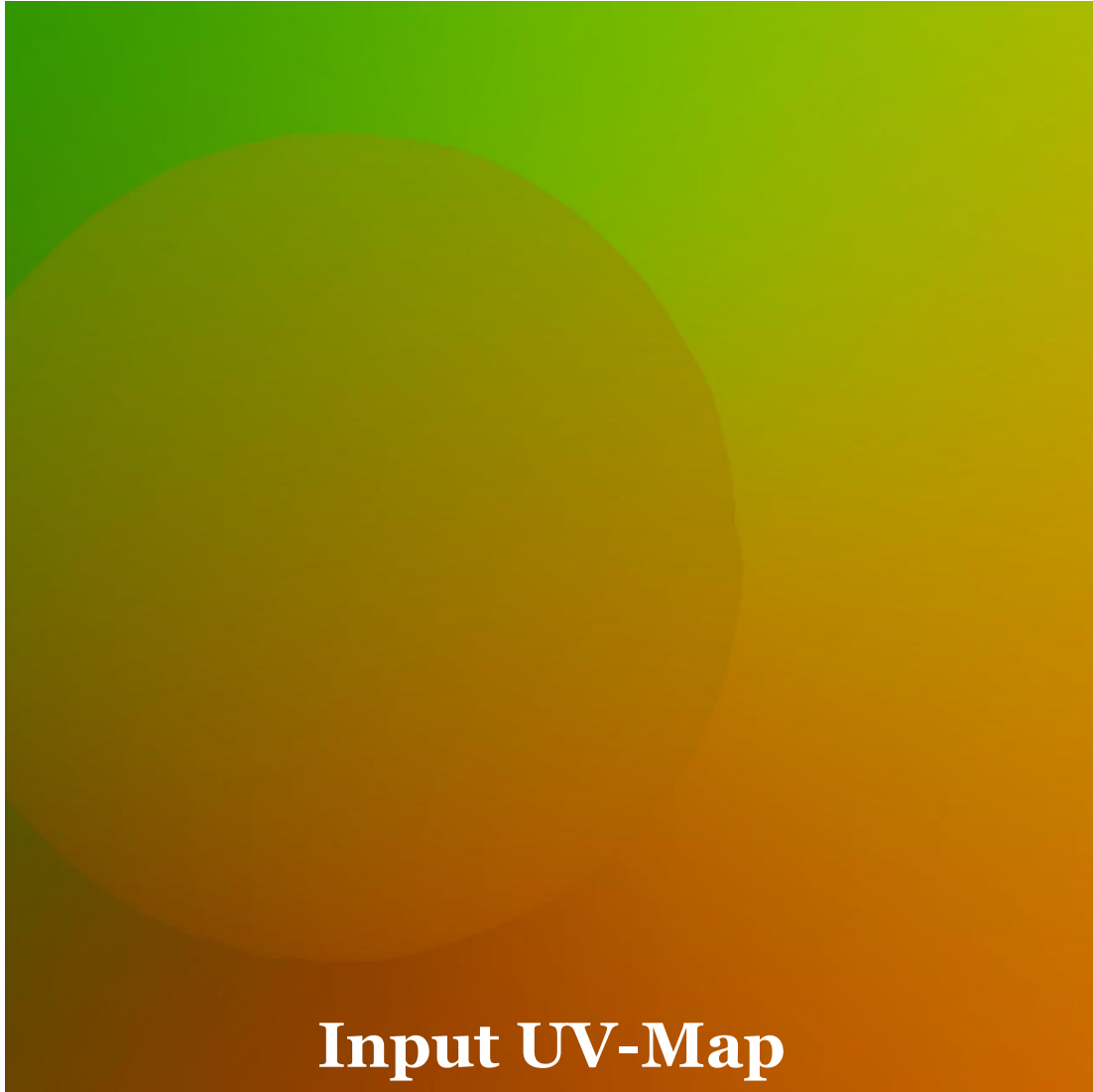
Neural Textures: Features on 3D Mesh



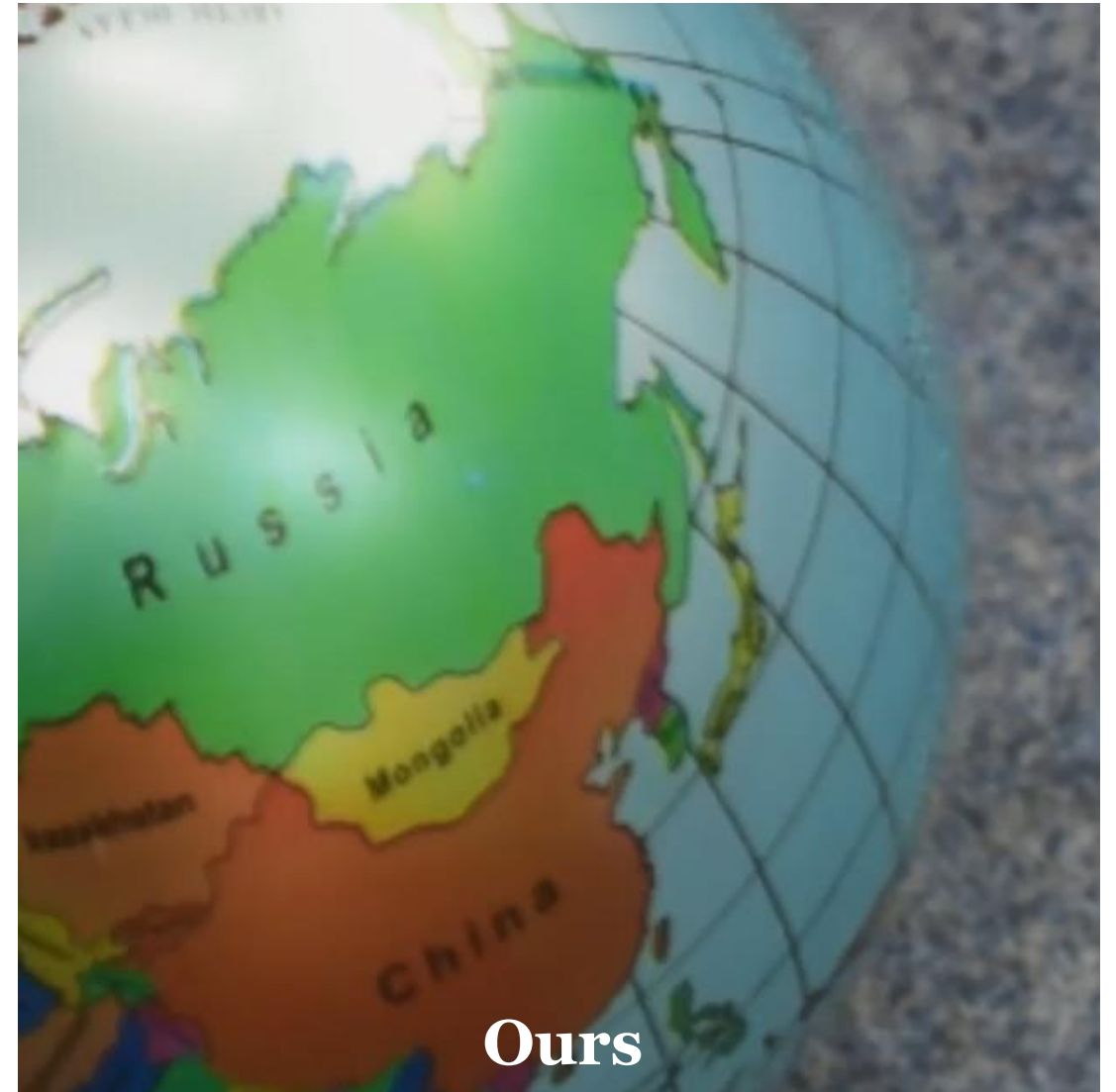
Neural Textures: Features on 3D Mesh



Novel View-Point Synthesis



Novel View-Point Synthesis



Scene Editing

Input
Sequence



Geometry
Editing



Scene Editing



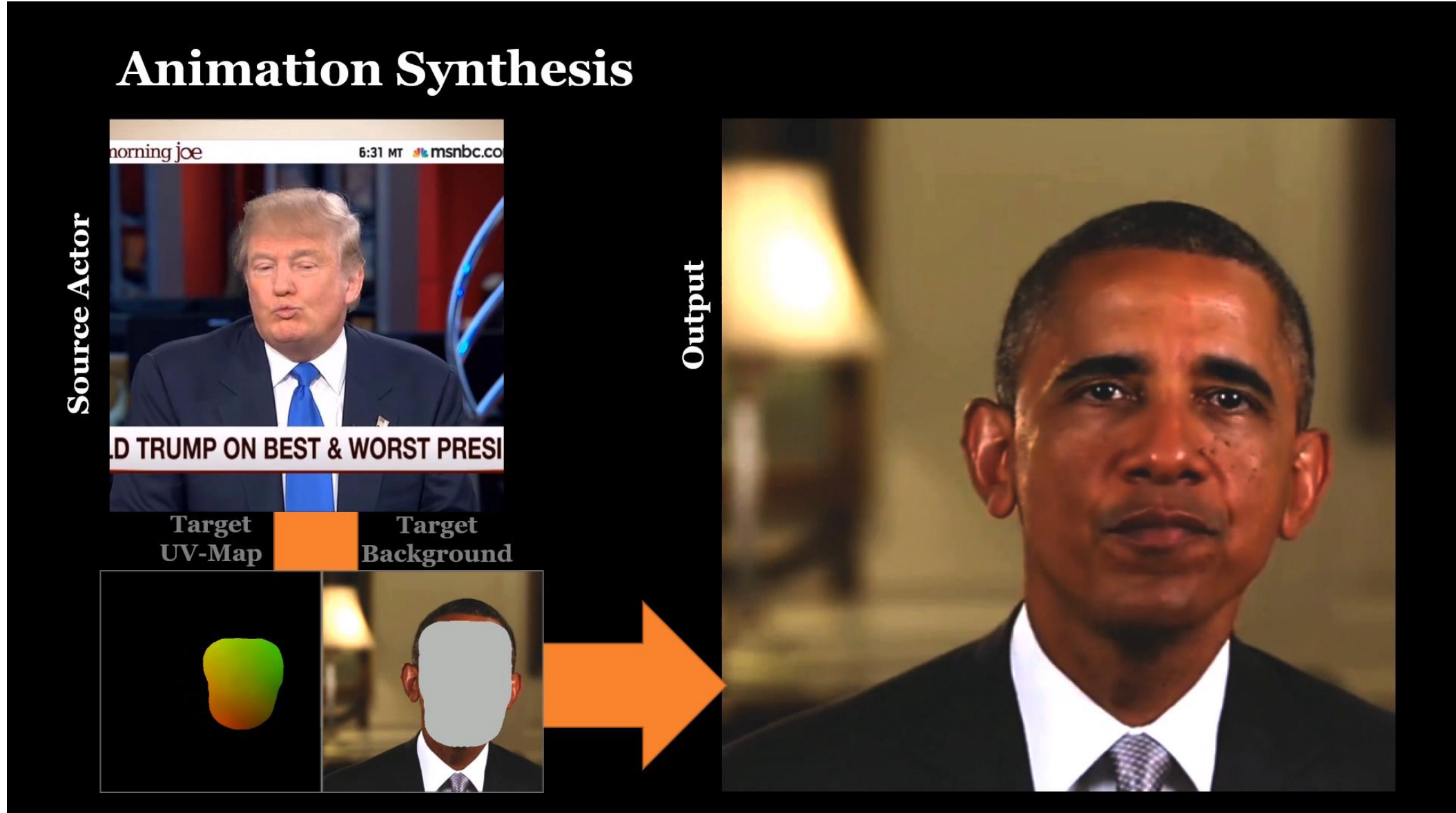
Siggraph'19 [Thies et al.]: Neural Textures

Scene Editing

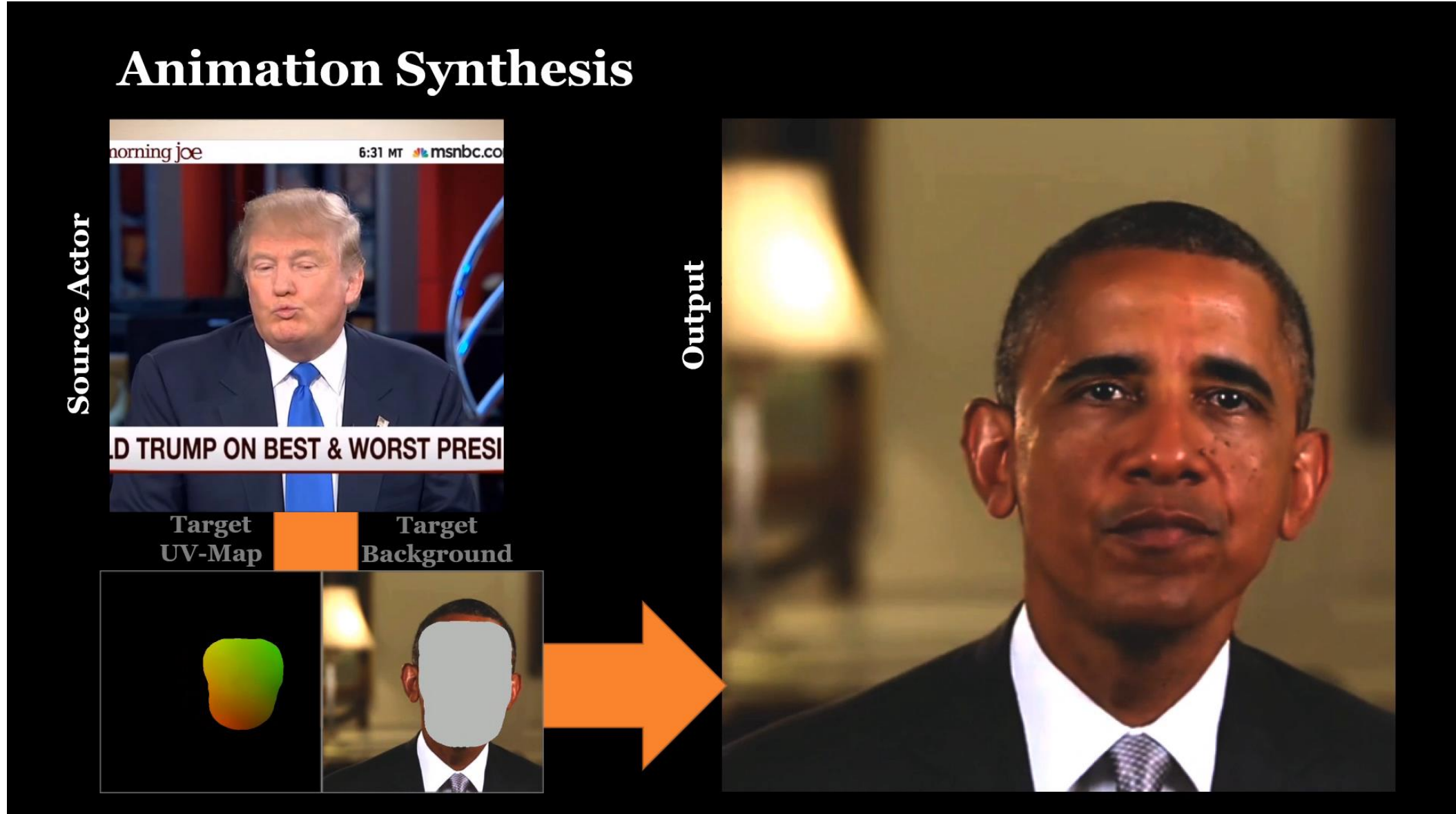


Siggraph'19 [Thies et al.]: Neural Textures

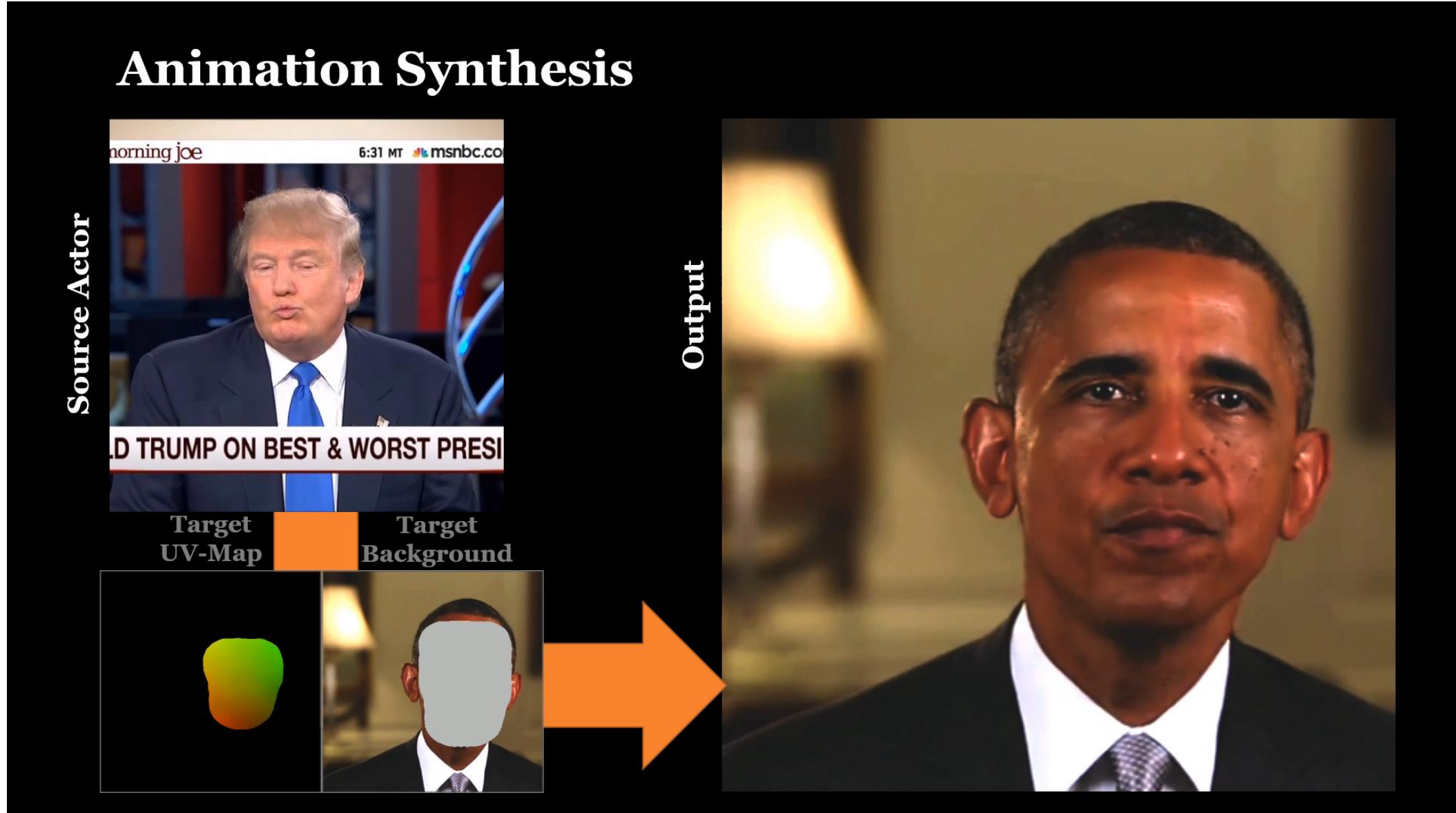
Facial Animation



Facial Animation



Facial Animation



Deferred Neural Rendering

Animation Synthesis

Source Actor



Target
UV-Map



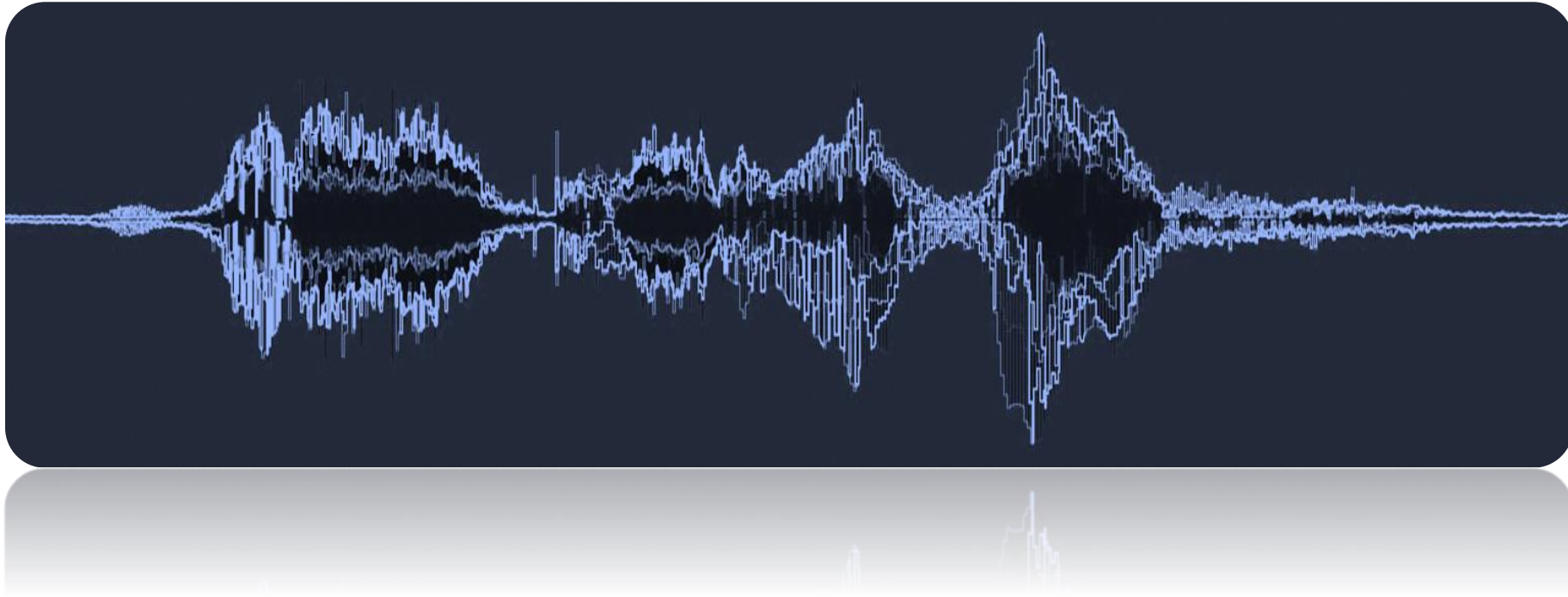
Target
Background



Output

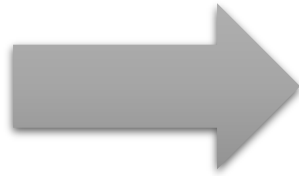
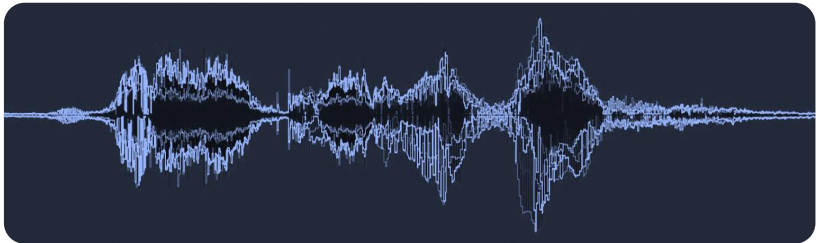


Conditioning on Audio: Neural Voice Puppetry



Audio to Video

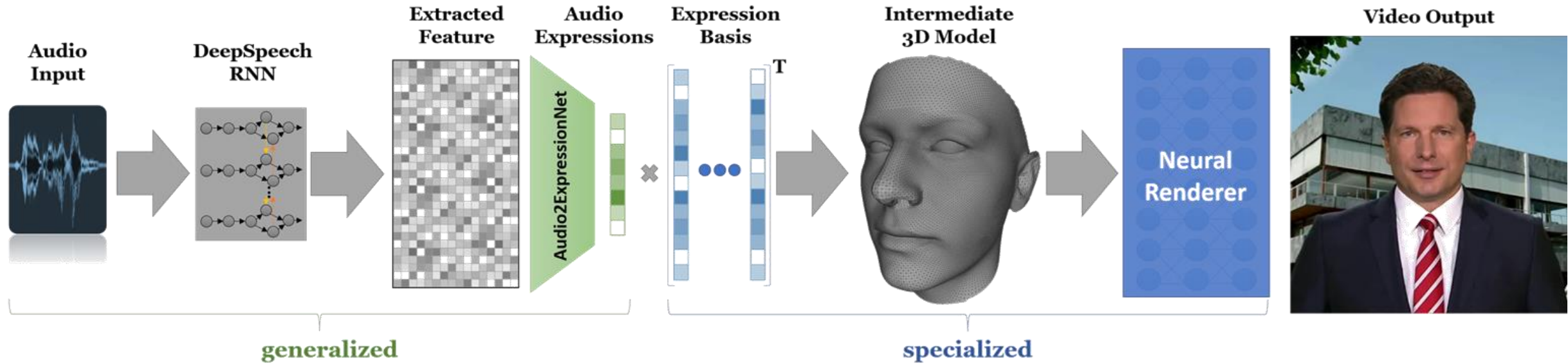
English Audio



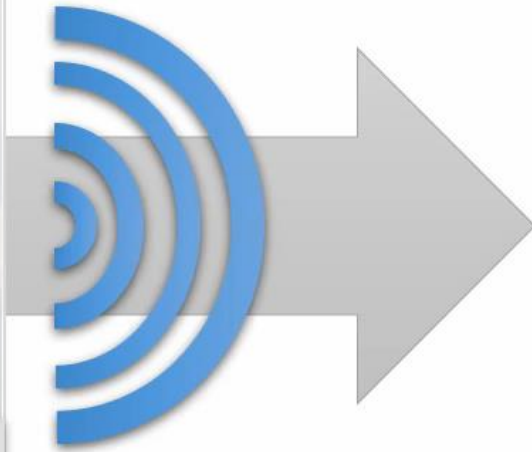
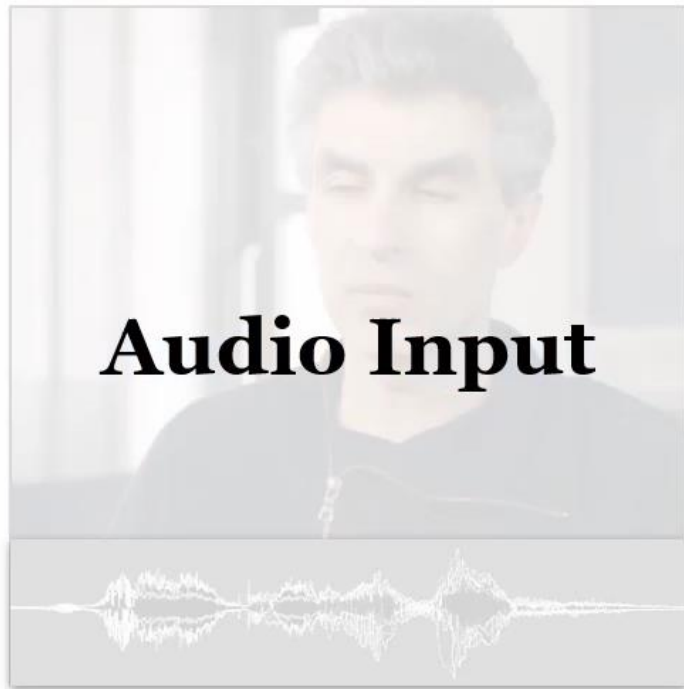
German News Video



Neural Voice Puppetry



Neural Voice Puppetry: Audio to Video



Neural Radiance Fields

Neural Radiance Fields

NeRF

Representing Scenes as Neural Radiance Fields for View Synthesis

ECCV 2020 Oral - Best Paper Honorable Mention

[Ben Mildenhall](#)*

UC Berkeley

[Pratul P. Srinivasan](#)*

UC Berkeley

[Matthew Tancik](#)*

UC Berkeley

[Jonathan T. Barron](#)

Google Research

[Ravi Ramamoorthi](#)

UC San Diego

[Ren Ng](#)

UC Berkeley

*Denotes Equal Contribution



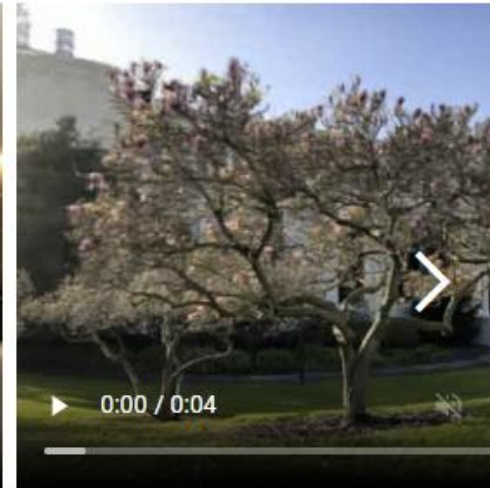
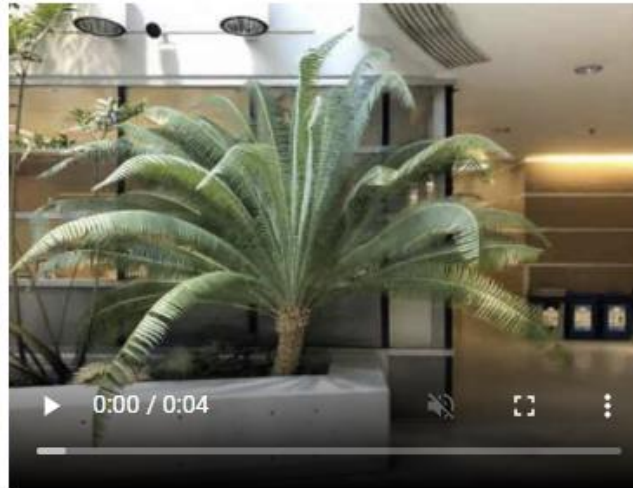
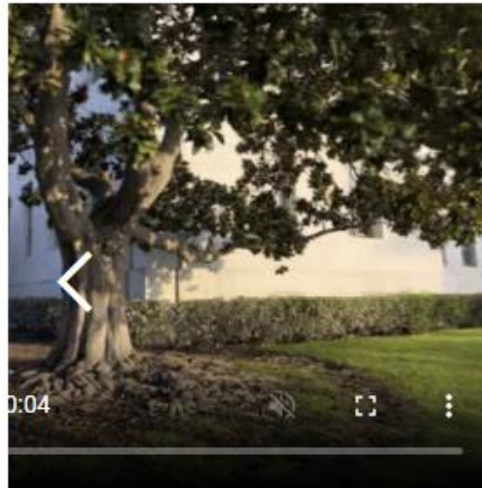
Paper



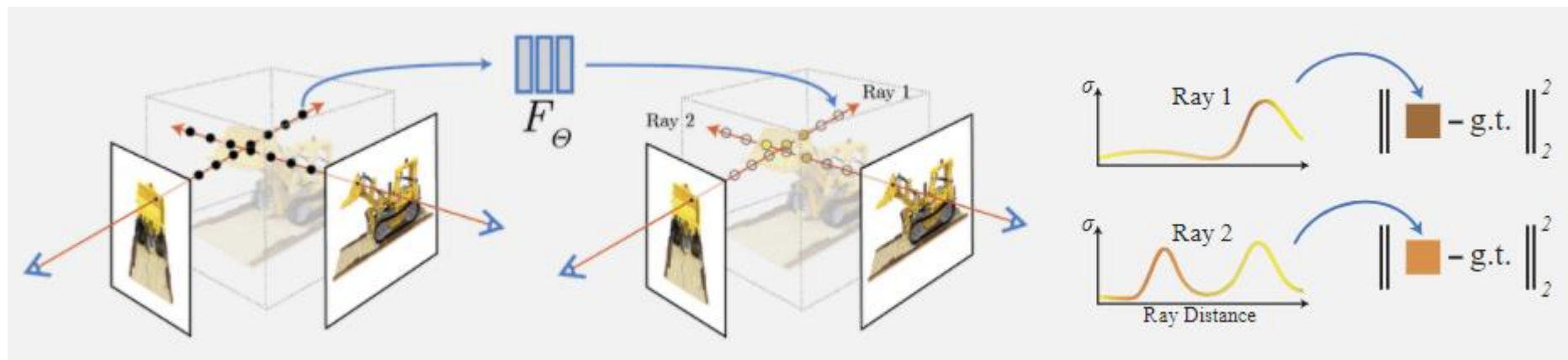
</Code>



Data

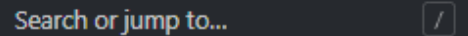


Neural Radiance Fields



$$(x, y, z, \theta, \phi) \rightarrow \begin{array}{c} \text{Neural Network} \\ F_\theta \end{array} \rightarrow (RGB\sigma)$$

← → ↻ 🔒 github.com/yenchenlin/awesome-NeRF



 [yenchelin / awesome-NeRF](#)

main 1 branch 0 tags

Add file ▾

↓ Code ▾

yenchenlin Merge pull request #12 from cfoster0/main ...

b5034fd 2 hours ago 43 commits

 citations Added NeRV 10 hours ago

 LICENSE Initial commit 12 days ago

 README.md Typo fix. 10 hours ago

Awesome Neural Radiance Fields

A curated list of awesome neural radiance fields papers, inspired by [awesome-computer-vision](#).

- Papers

A curated list of awesome neural radiance fields papers

nerf

 [Readme](#)

 MIT License

No releases published

Packages

No packages published

Contributors 8

Dynamic Neural Radiance Fields for 4D Avatars

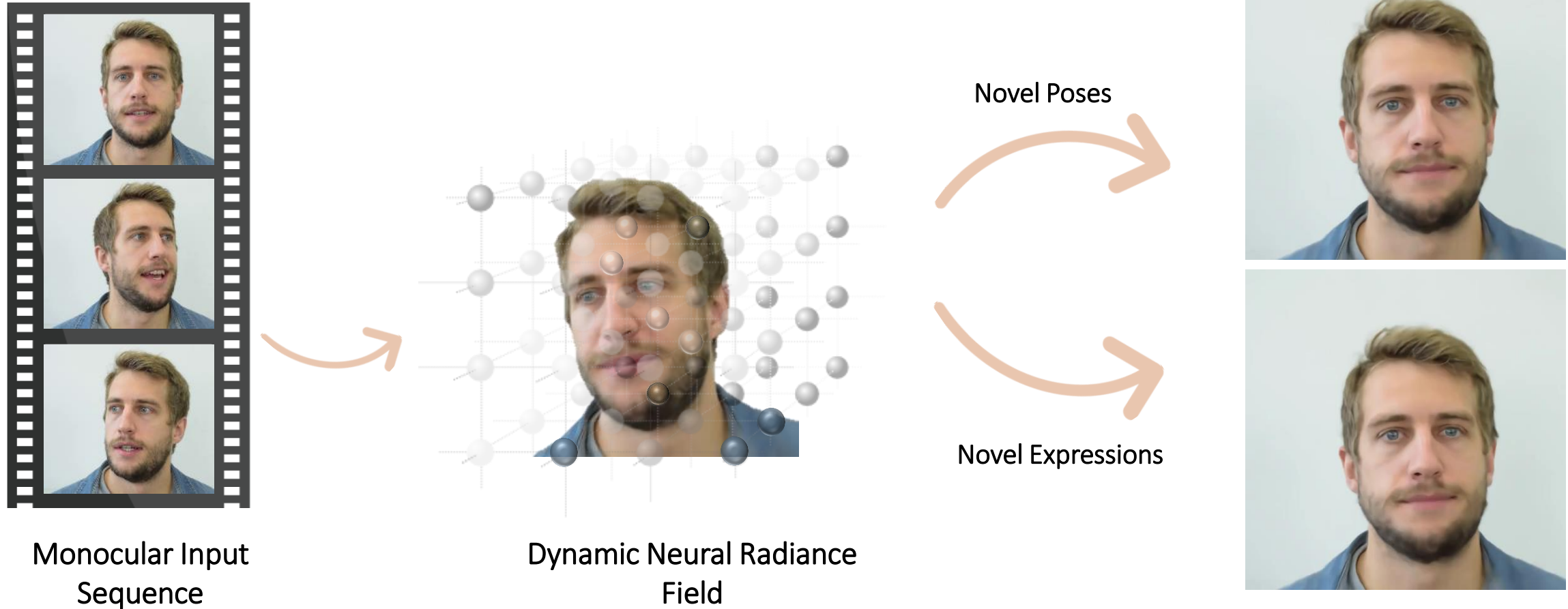


Monocular Input
Sequence

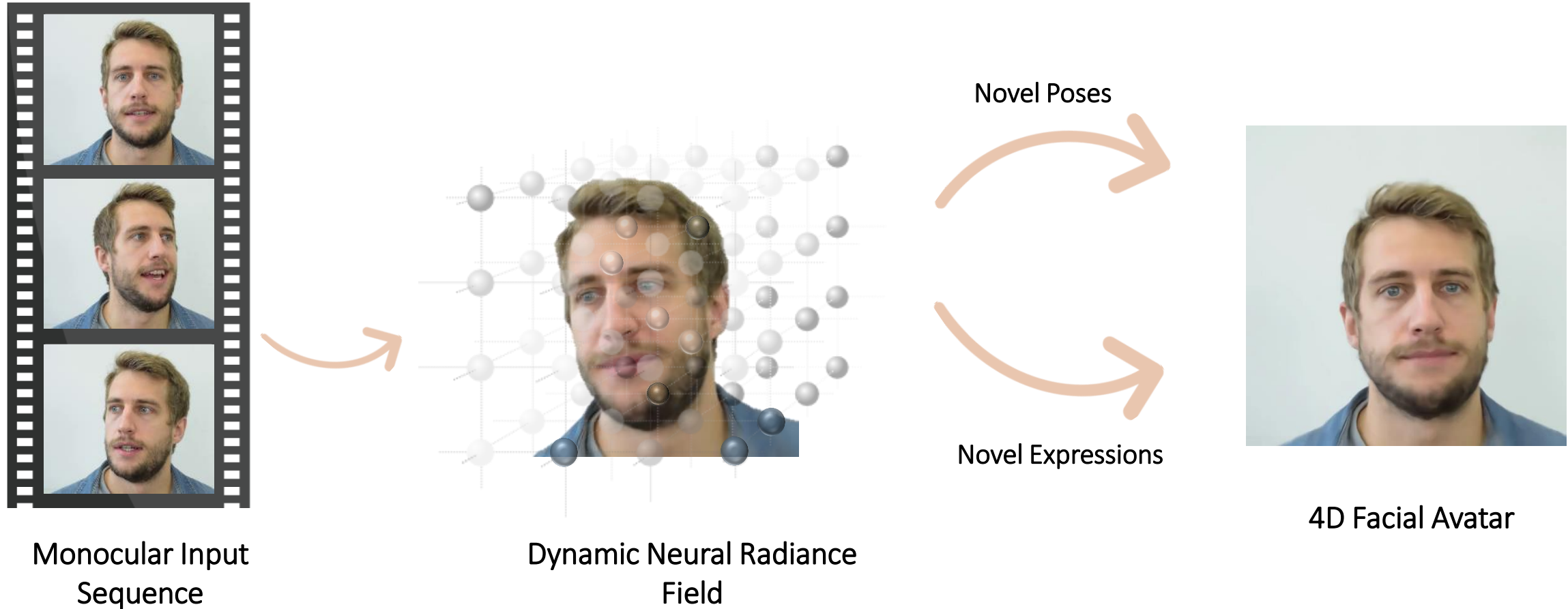


Dynamic Neural Radiance
Field

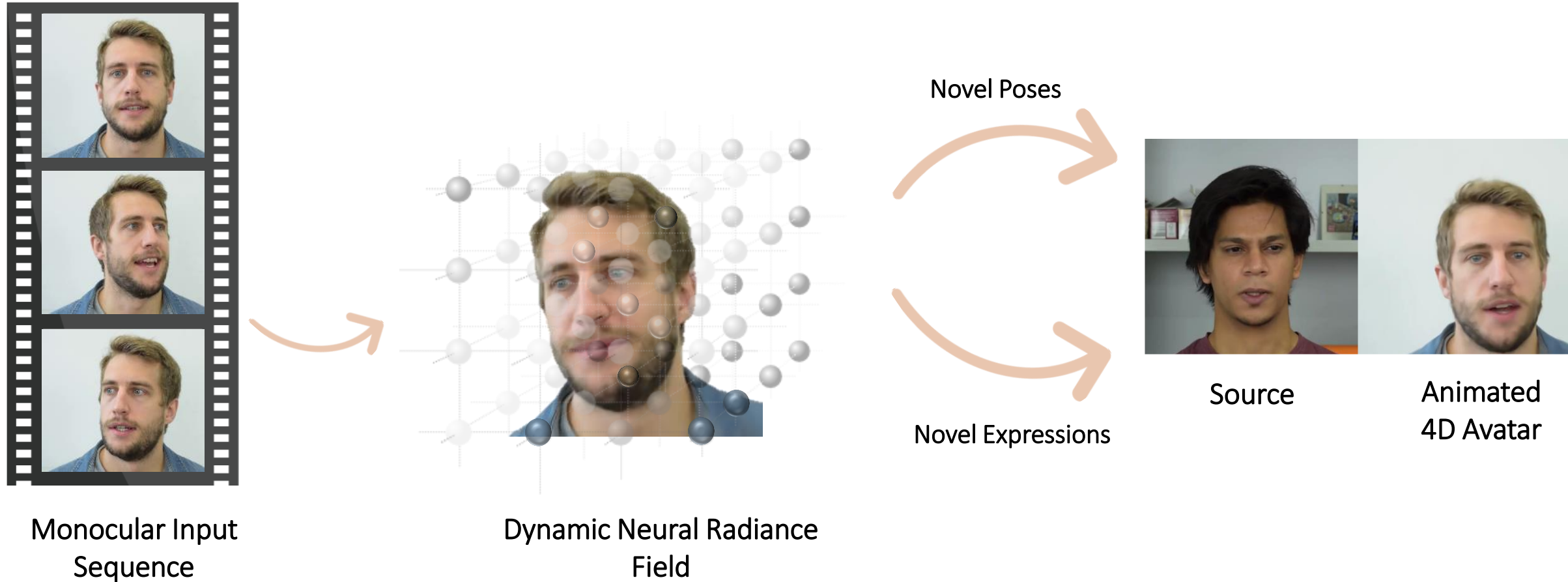
Dynamic Neural Radiance Fields for 4D Avatars



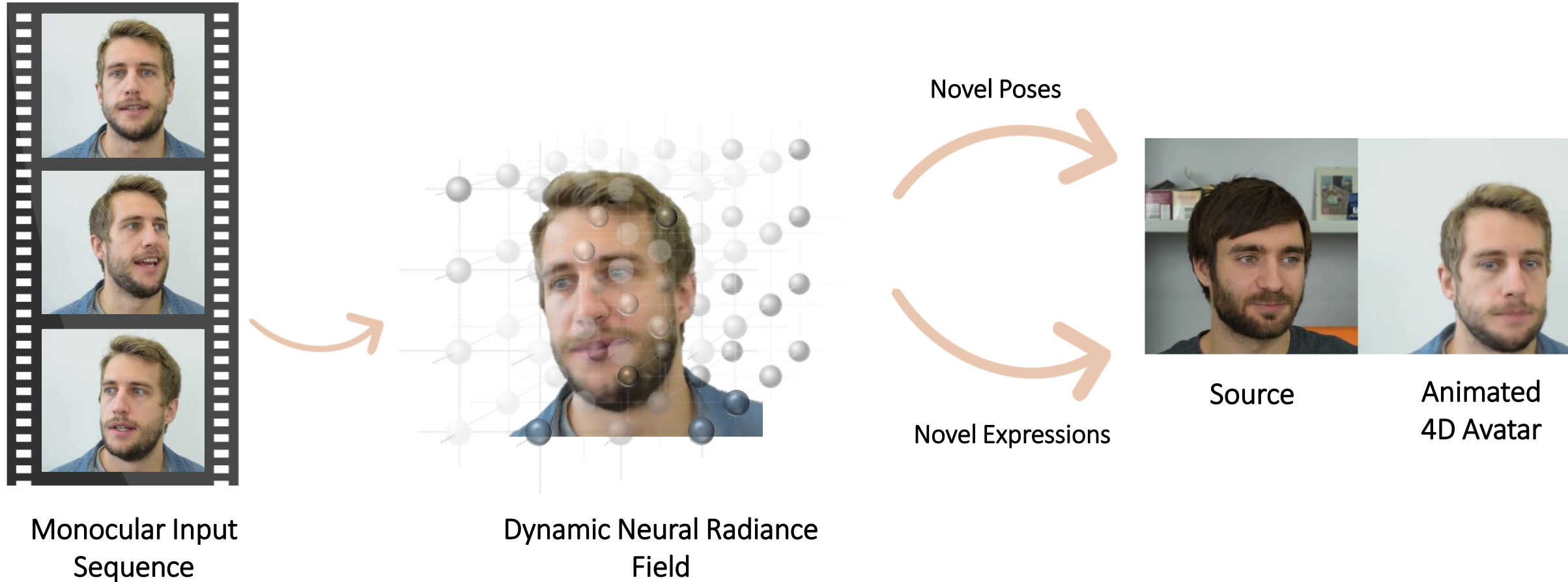
Dynamic Neural Radiance Fields for 4D Avatars



Dynamic Neural Radiance Fields for 4D Avatars



Dynamic Neural Radiance Fields for 4D Avatars



Method – 3DMM



Input Frames



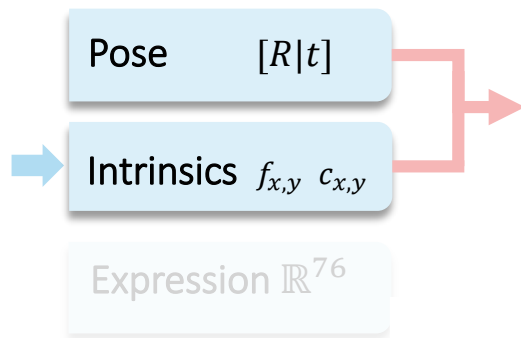
Method – 3DMM



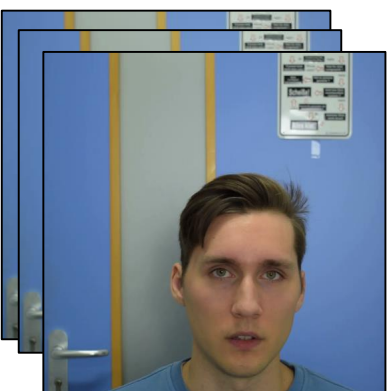
Input Frames



3DMM



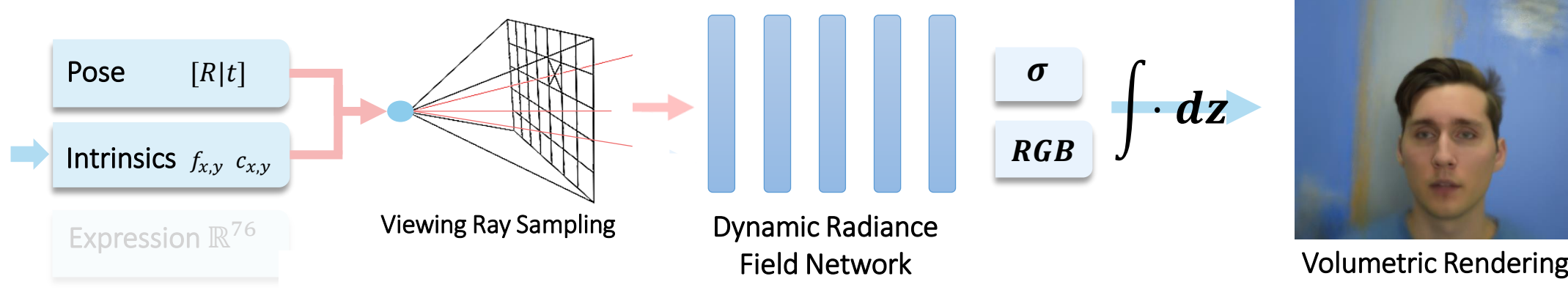
Method - Background



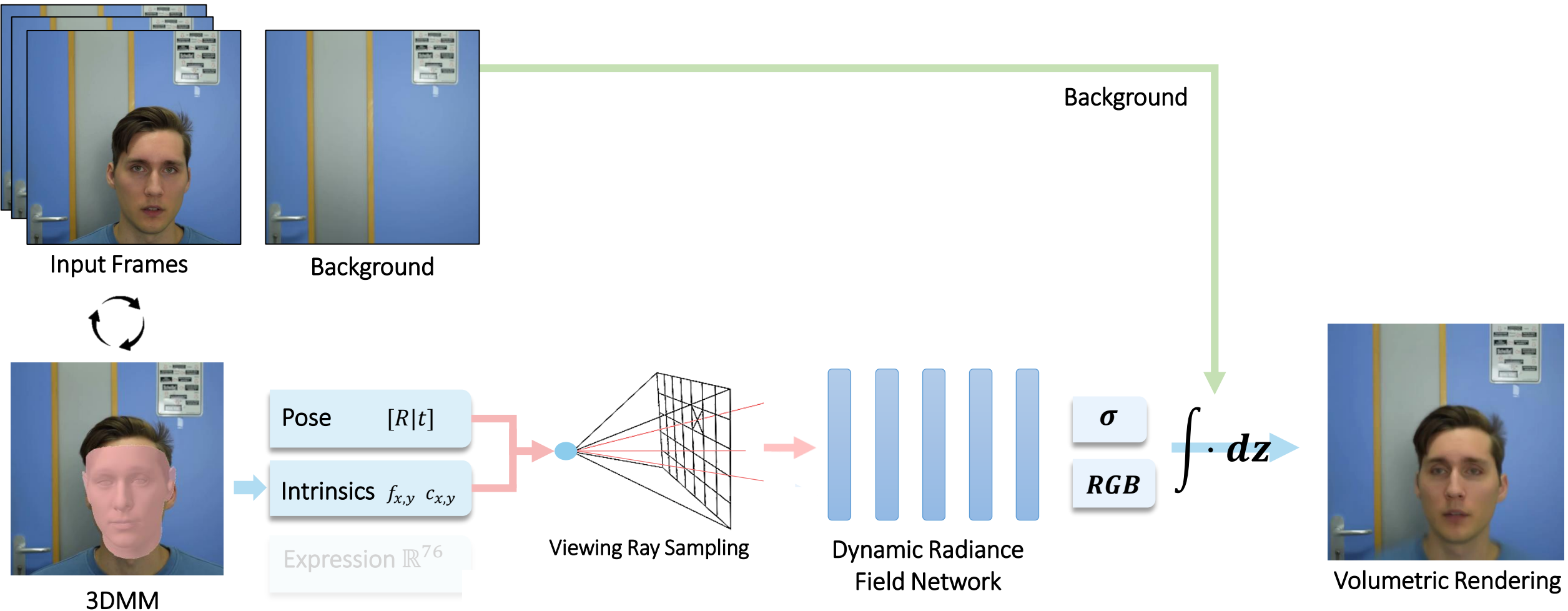
Input Frames



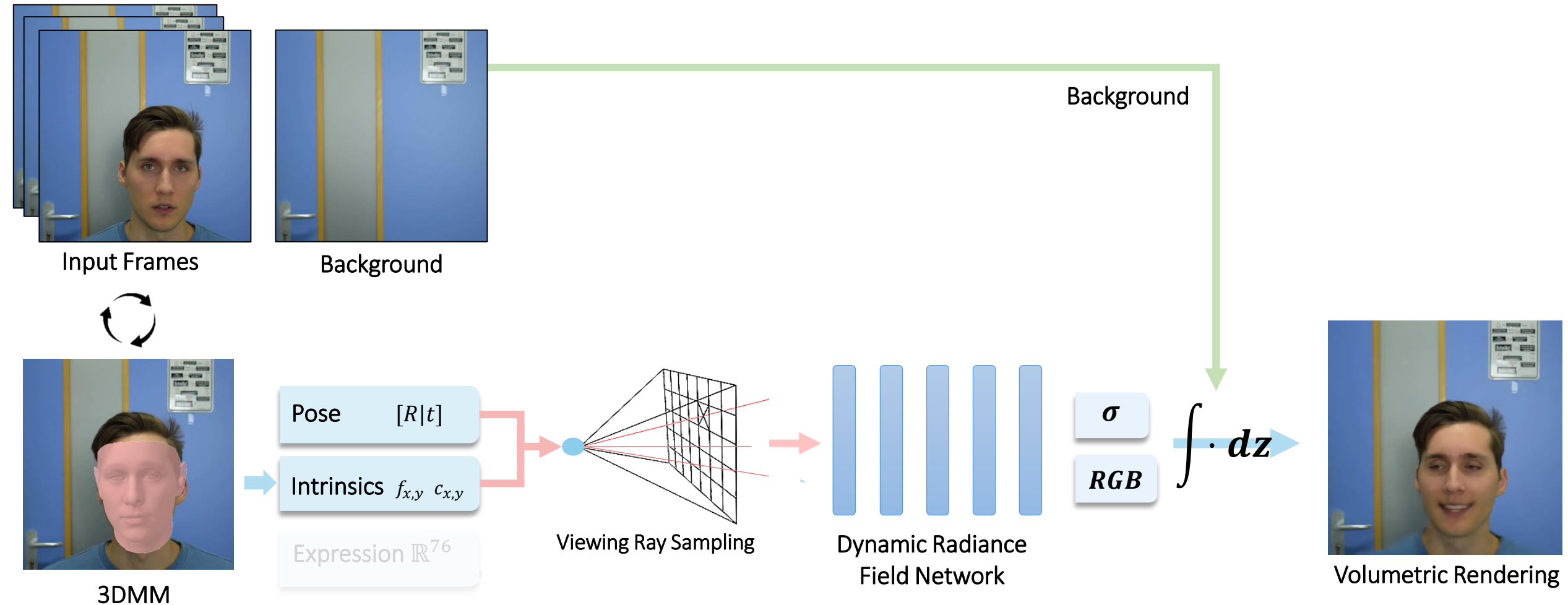
3DMM



Method - Background



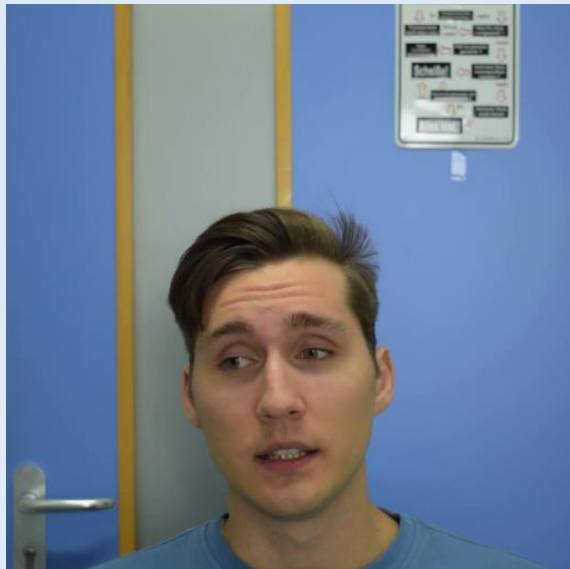
Method - Dynamics



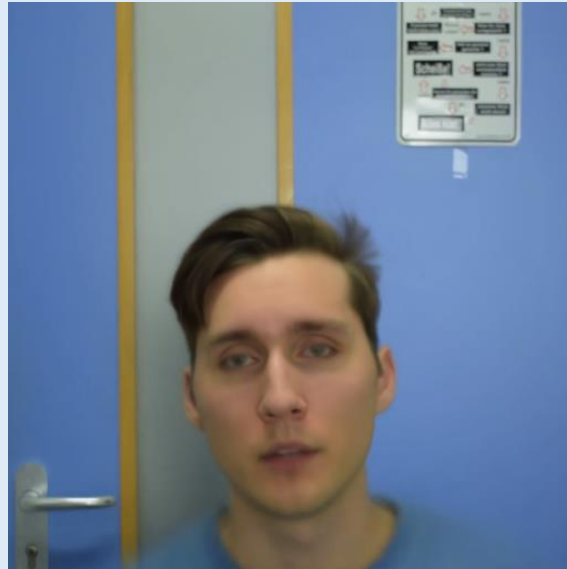
Method - Dynamics

Background

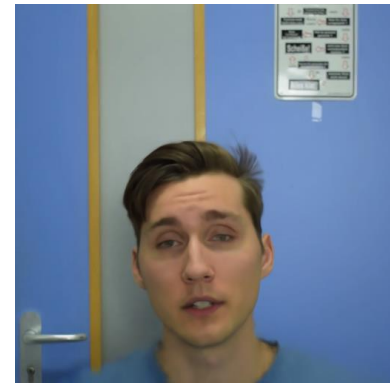
Ground Truth



No Expression Conditioning

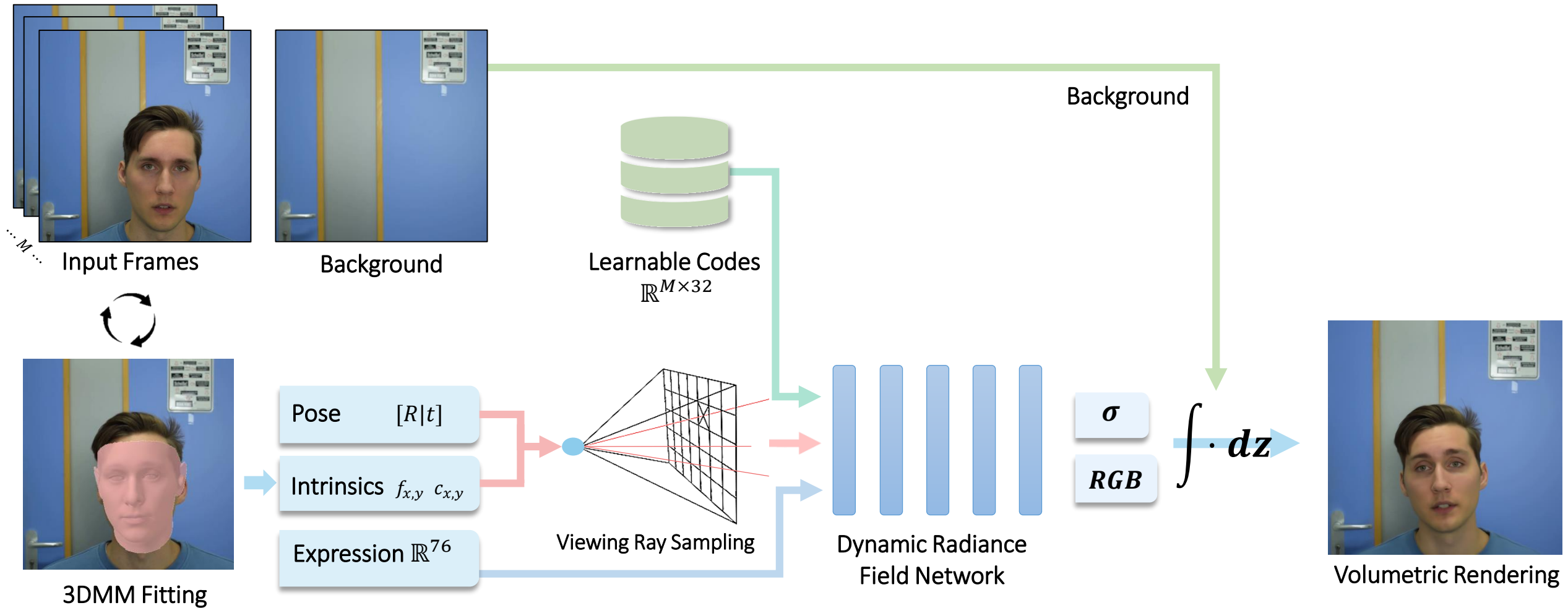


With Expression Conditioning



Volumetric Rendering

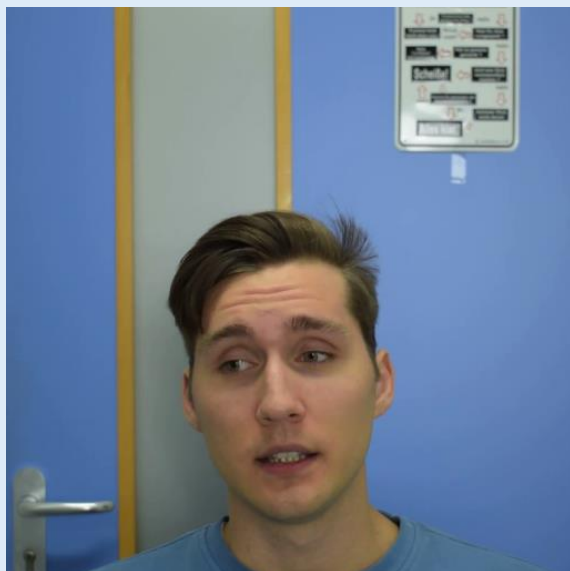
Method - Dynamics



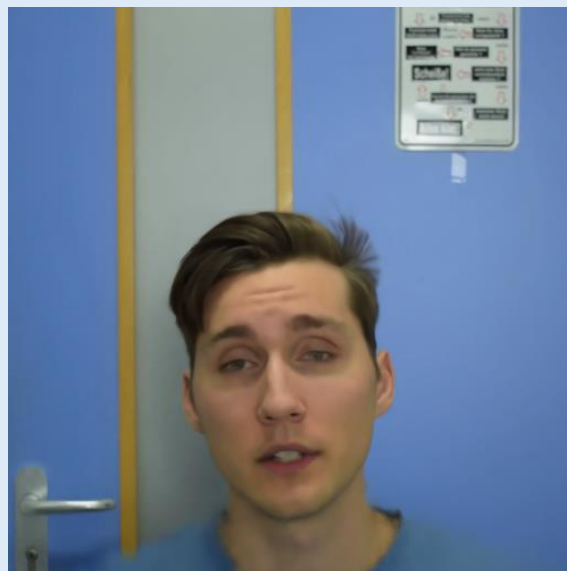
Method - Dynamics

Background

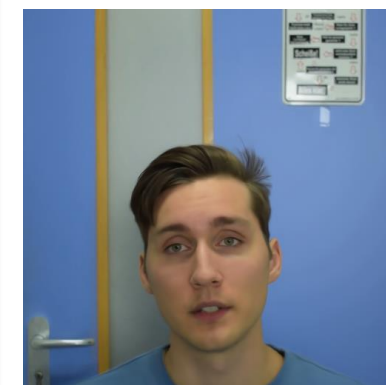
Ground Truth



No Latent Code



With Latent Code

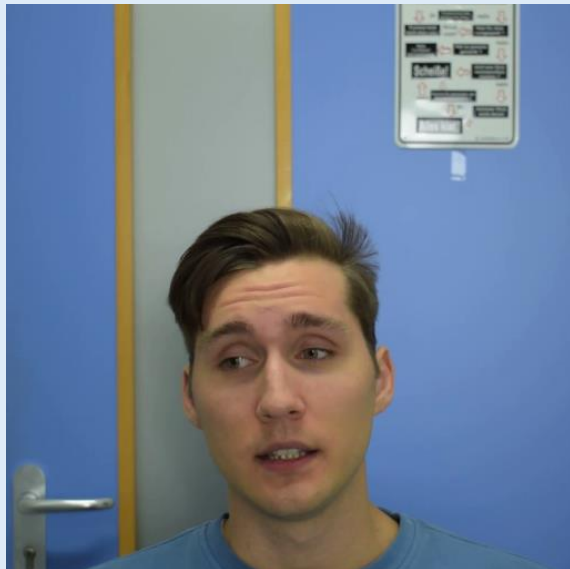


Volumetric Rendering

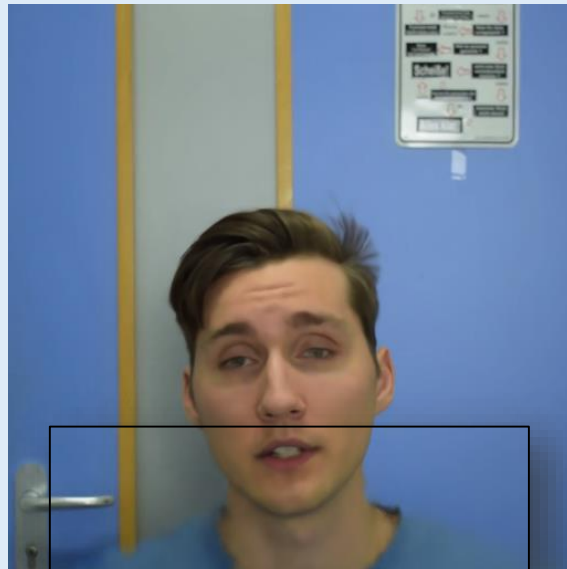
Method - Dynamics

Background

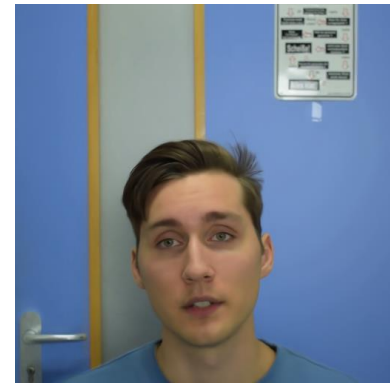
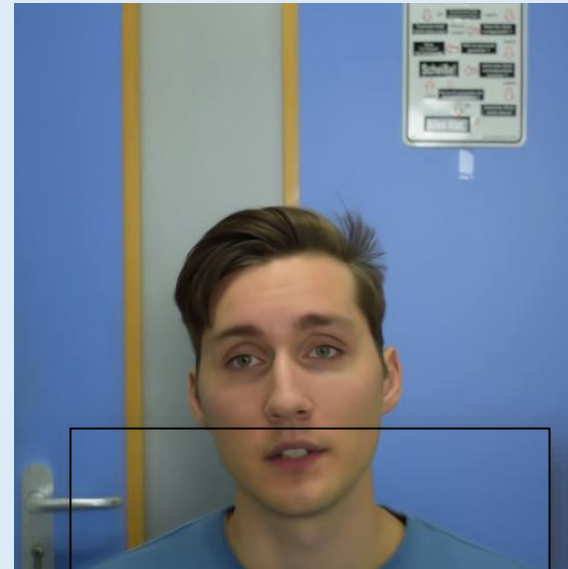
Ground Truth



No Latent Code



With Latent Code



Volumetric Rendering

Results



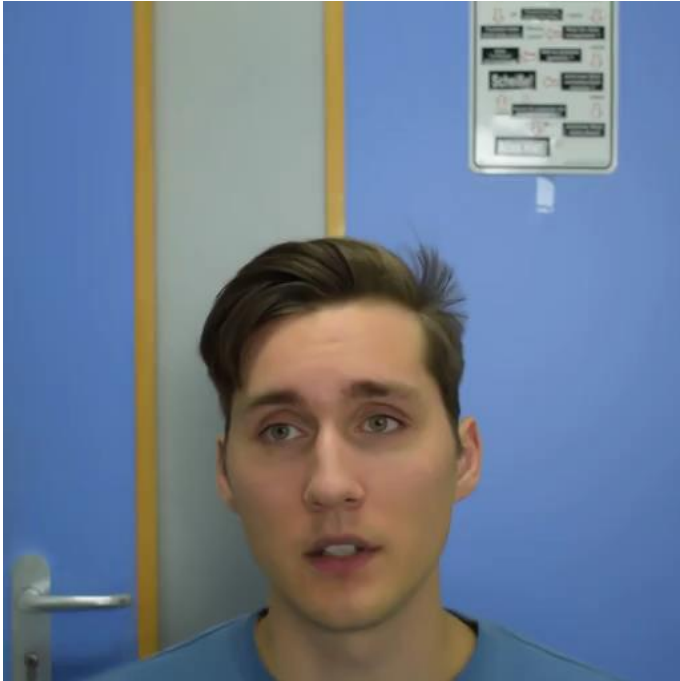
Control Pose



Control Expression

Estimated Normals

Results



Unseen Expressions
Fixed Pose



Estimated Normals

Comparisons



First Order Motion Models

[Siarohin et al. '19]

Deep Video Portraits

[Kim et al. '19]

Ours

Ground Truth

Comparisons



First Order Motion Models

[Siarohin et al. '19]

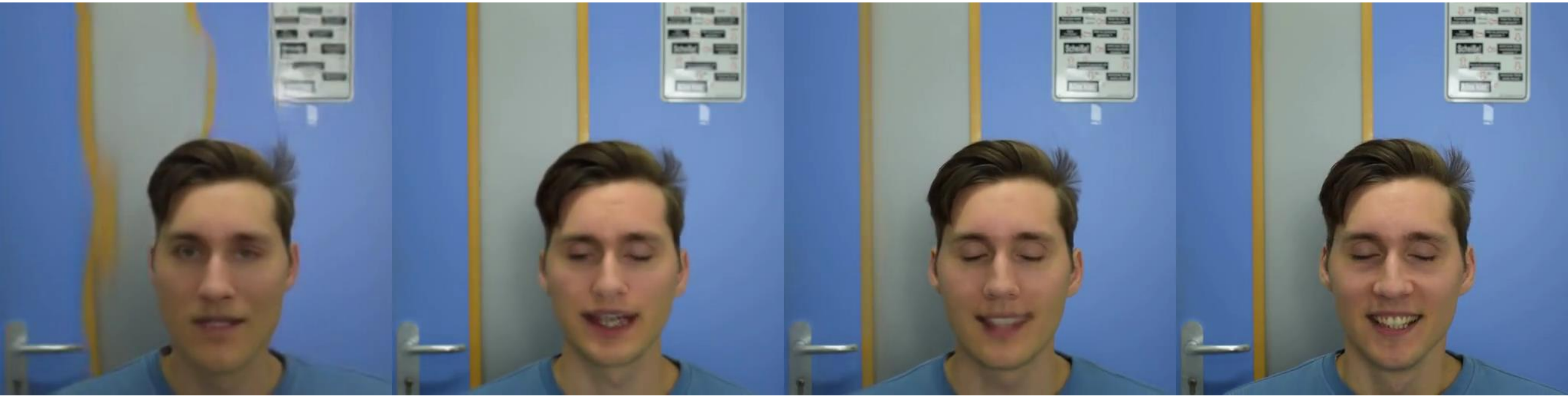
Deep Video Portraits

[Kim et al. '19]

Ours

Ground Truth

Comparisons



First Order Motion Models

[Siarohin et al. '19]

Deep Video Portraits

[Kim et al. '19]

Ours

Ground Truth

Applications - Reenactment



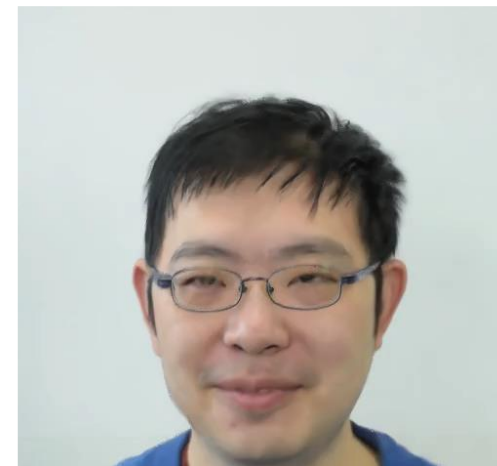
Source Actor



Our Result



Source Actor



Our Result

So why is Neural Rendering so cool?

Digital 3D Reconstruction



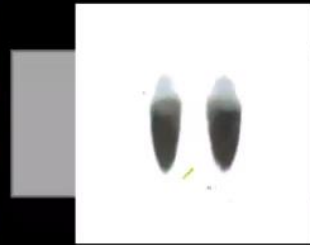
Photo-realistic Reconstruction

How much can AI do?

Using a Bounding Box as Proxy



Input UV-Map



**Sampled
Texture**



Ours



Ground Truth

Towards Holograms & AI Avatars 😊





Prof. Dr. Matthias
Nießner



Dr. Justus Thies



Dr. Yinyu Nie



Angel X. Chang
Visiting Professor:
Hans Fischer Fellow
Princeton University



Leonidas Guibas
Visiting Professor:
Hans Fischer Senior
Fellow
Stanford University



Luisa Verdola
Visiting Professor: Hans
Fischer Senior Fellow
University of Naples Federico
II

Thanks!

PhD Students



Aljaž Božič



Andrei Burov



Armen Avetisyan



Barbara Rössle



Dejan Azinović



Ji Hou (侯驥)



Norman Müller



Yawar Siddiqui



Andrei Burov



Guy Gafni



Shivangi Aneja



Dave Zhenyu Chen