Montage4D: Interactive Seamless Fusion of Multiview Video Textures

Ruofei Du[†‡], Ming Chuang[‡¶], Wayne Chang[‡], Hugues Hoppe[‡§], and Amitabh Varshney[†]

[†]Augmentarium | UMIACS | University of Maryland, College Park

[‡]Microsoft Research, Redmond [¶]PerceptIn Inc. [§]Google Inc.

THE AUGMENTARIUM
VIRTUAL AND AUGMENTED REALITY LABORATORY
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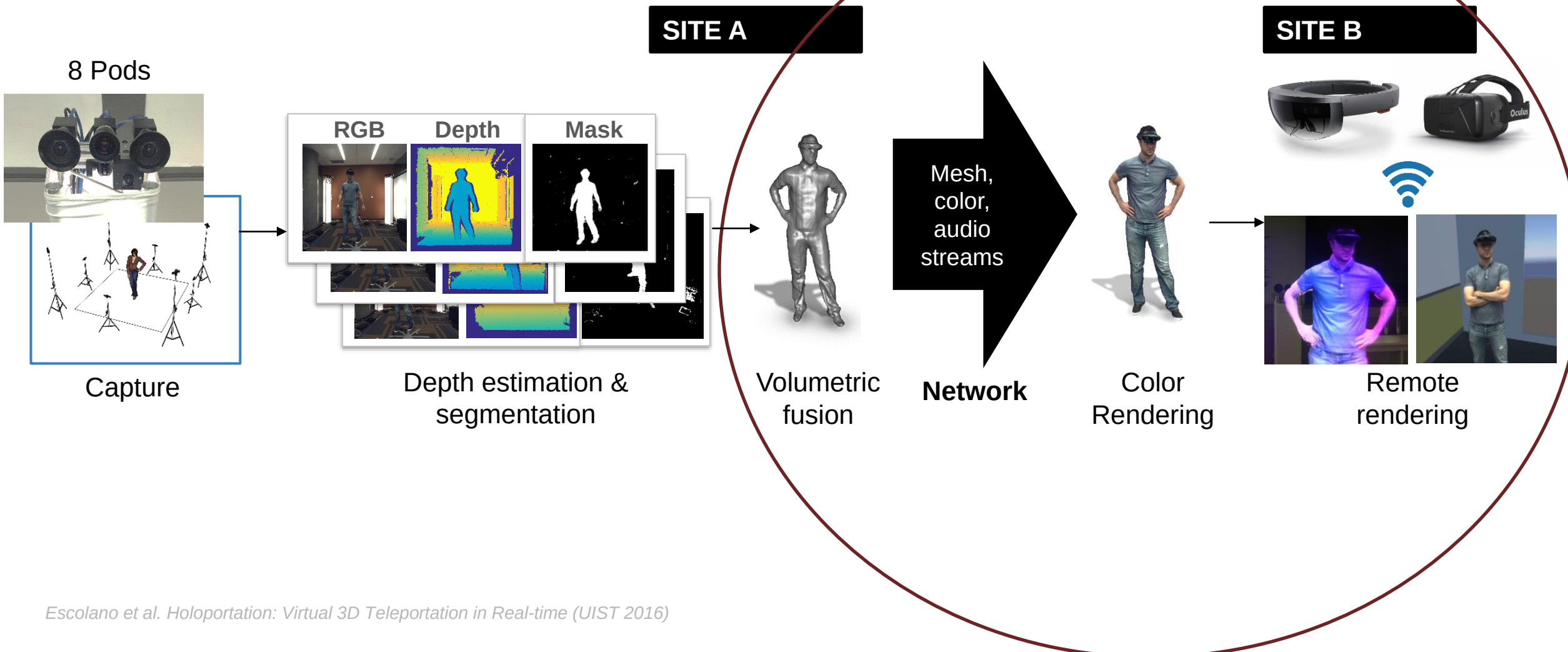
Introduction

Fusion4D and Holoportation



Escolano et al. Holoportation: Virtual 3D Teleportation in Real-time (UIST 2016)

Fusing multiview video textures onto dynamic task with real-time constraint is **a challenging task**

30%

of the users does not believe the 3D reconstructed person looks real

Motivation

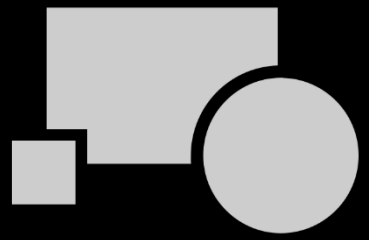
Visual Quality Matters

We notice the prior art has *blurring* and *seams*.

What are the **major causes**?

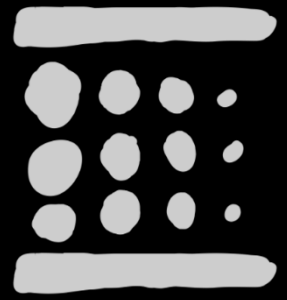
Motivation

Causes for Seams and Blurring



Self-occlusion

One or two vertices of the triangle are occluded in the depth map while the others are not.



View-dependent Rendering

Normal-weighted blending mixes colors from all views according to the normal vectors, but results in blurring faces. We emphasize the frontal views using view-dependent rendering techniques.

Field of View

One or two triangle vertices lie outside the camera’s field of view or in the subtracted background region while the rest are not.

Seams

Causes

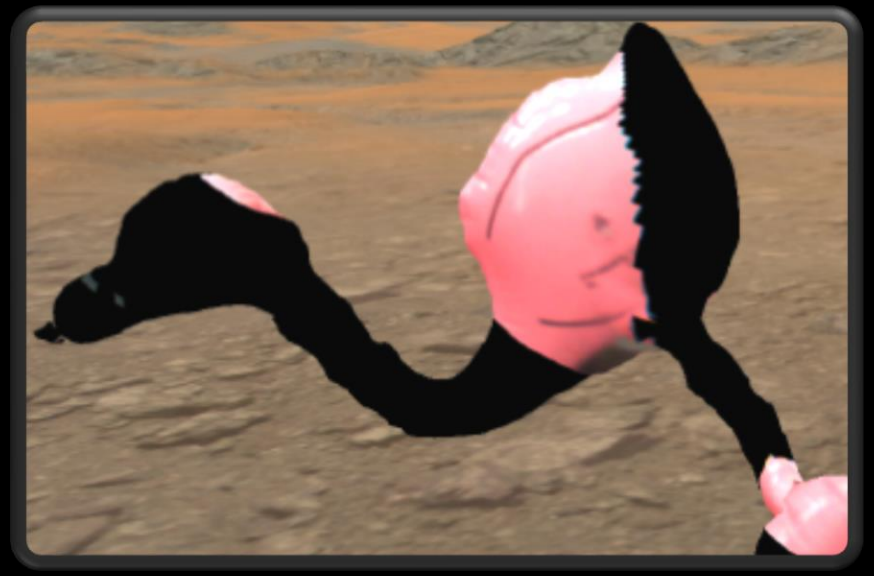
Raw projection mapping results

Seams after occlusion test

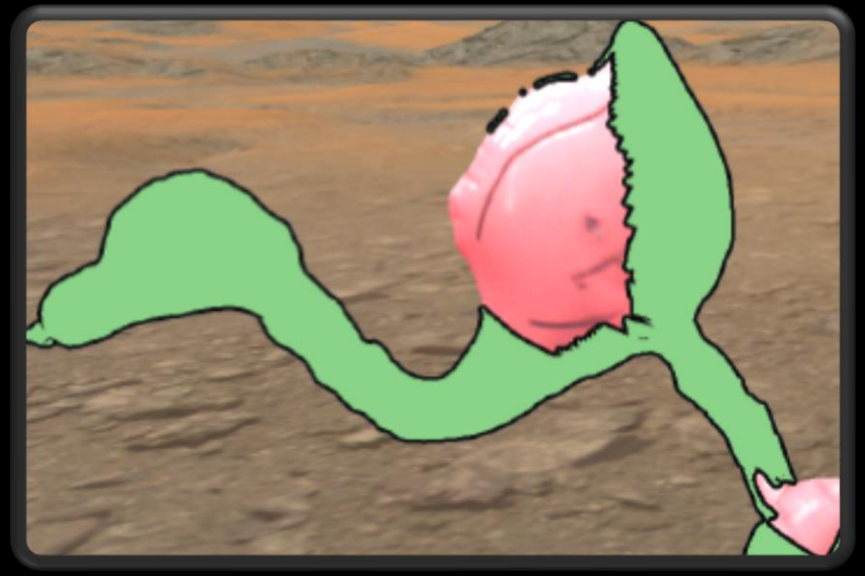
Seams after majority voting test

Seams

Causes



Raw projection mapping results

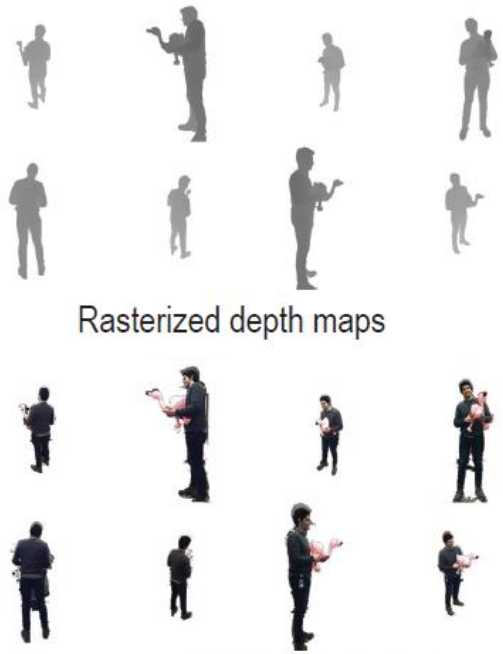


Seams after field-of-view test

Workflow

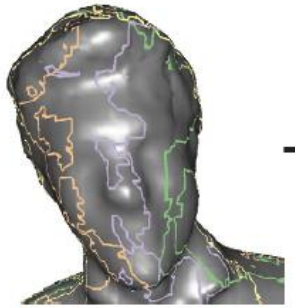
Identify and diffuse the seams

Input triangle meshes from *Fusion4D*



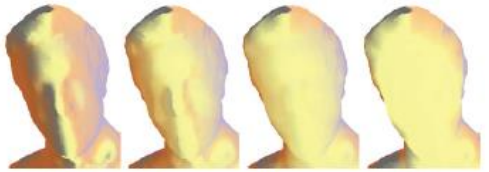
Rasterized depth maps

Texture maps with foreground segmentation



Seams caused by misregistration and occlusion

Discrete geodesic distance fields to diffuse texture fields from the seams

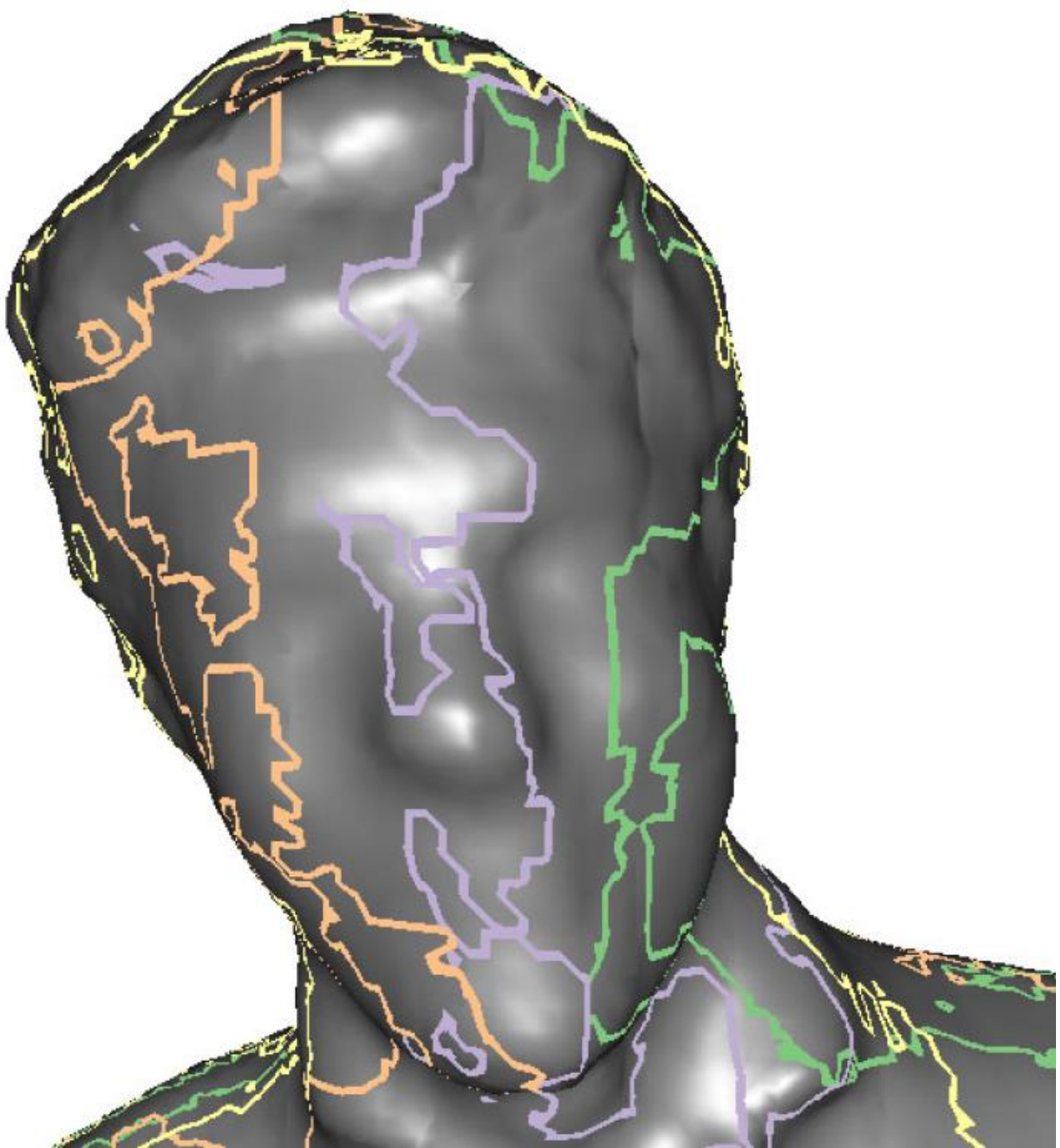


Update temporal texture fields

Montage4D Results

Seams

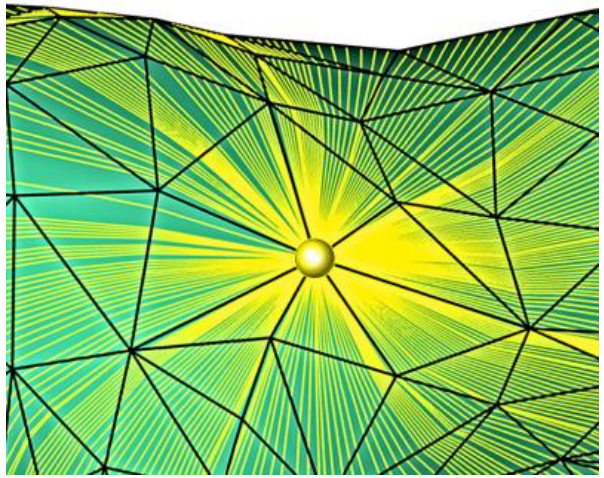
Causes



Geodesics

For diffusing the seams

Geodesic is the **shortest** route between two points on the surface.



On triangle meshes, this is challenging because of the computation of **tangent directions**.
And shortest paths are defined on **edges** instead of the vertices.

Approximate Geodesics

For diffusing the seams

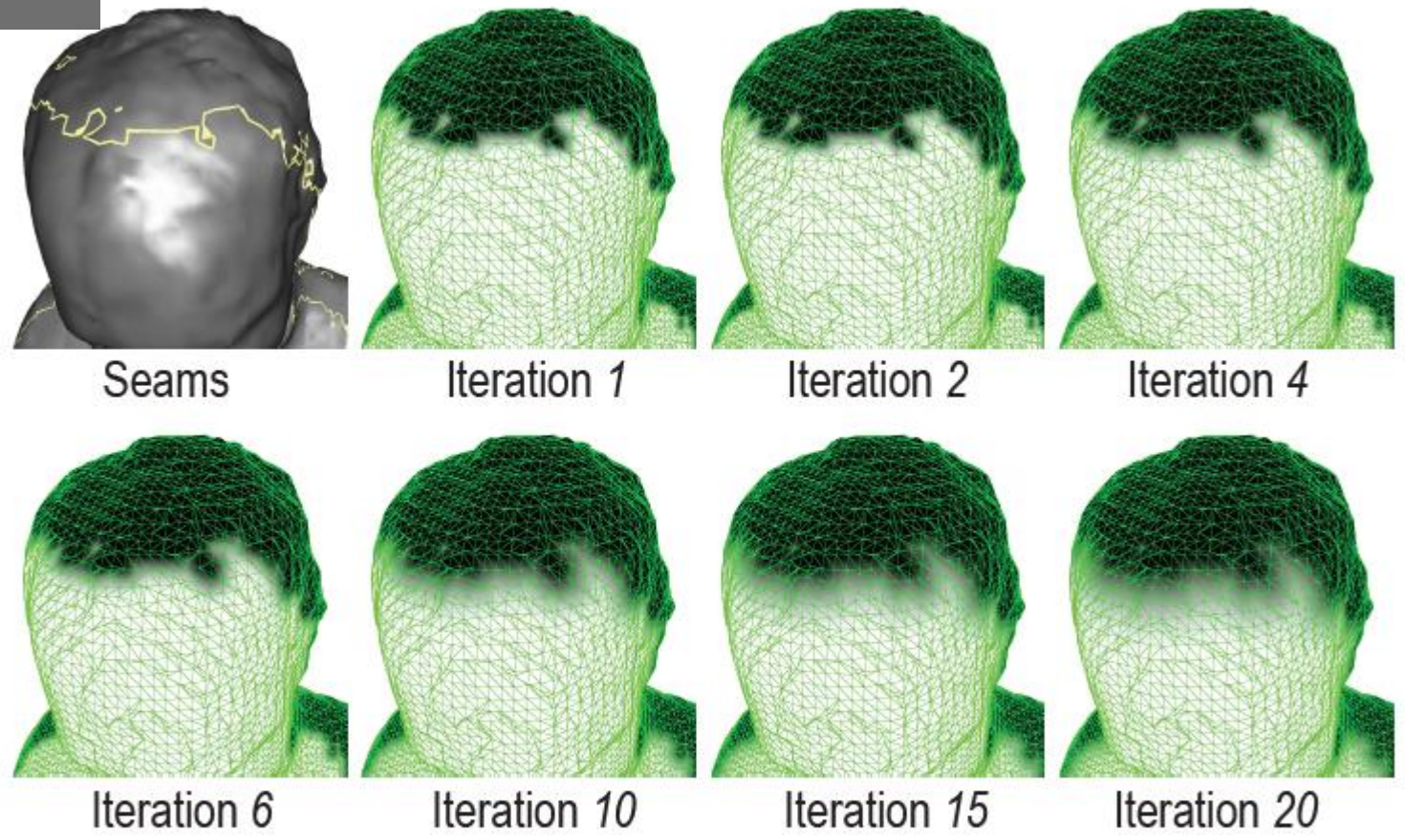
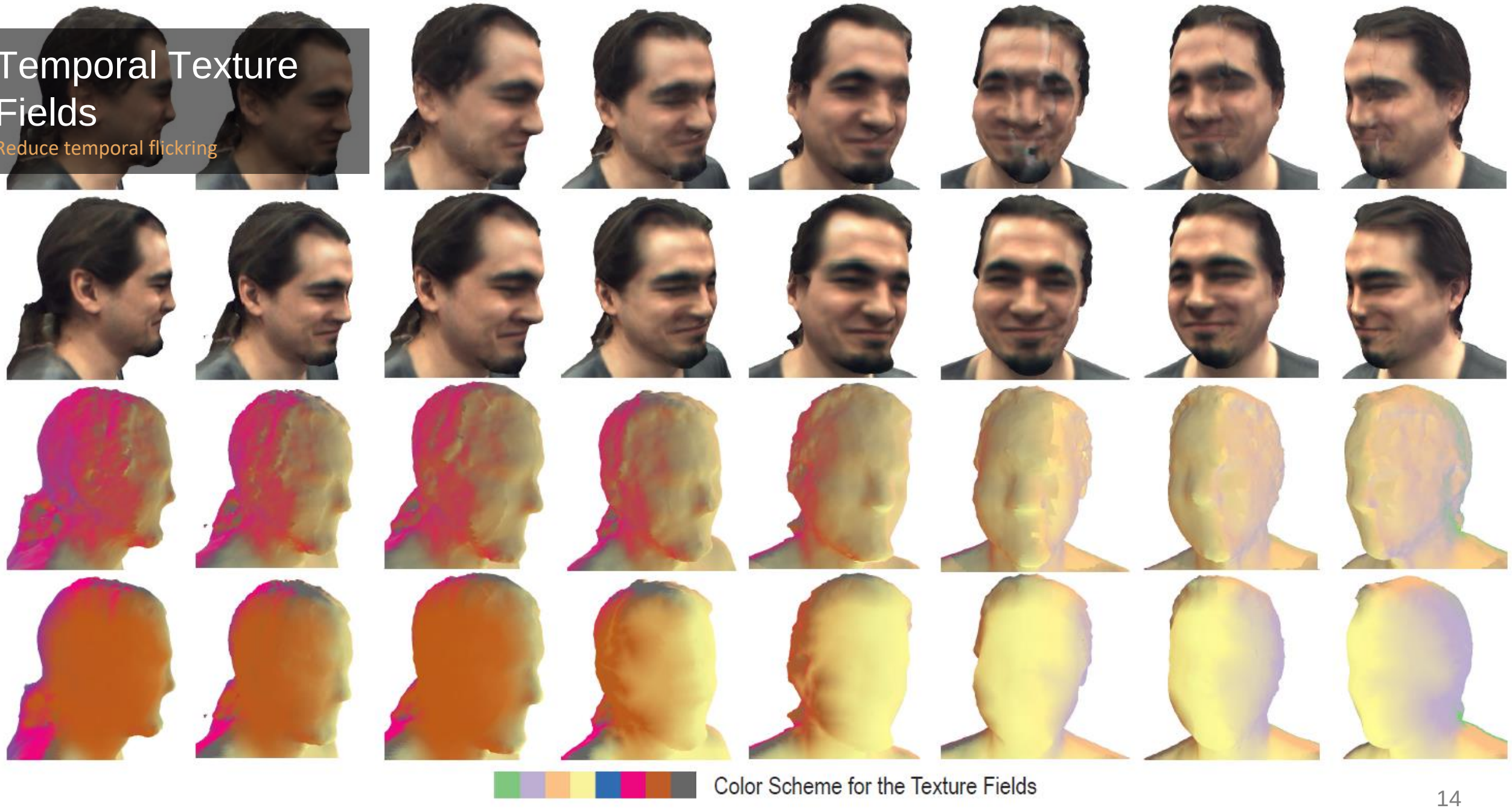


Figure 6: *Examples of the initial seam triangles and the propagation process for updating the geodesics.*

Temporal Texture Fields

Reduce temporal flickring



Color Scheme for the Texture Fields

Temporal Texture Fields

Transition between views

Exmperiment

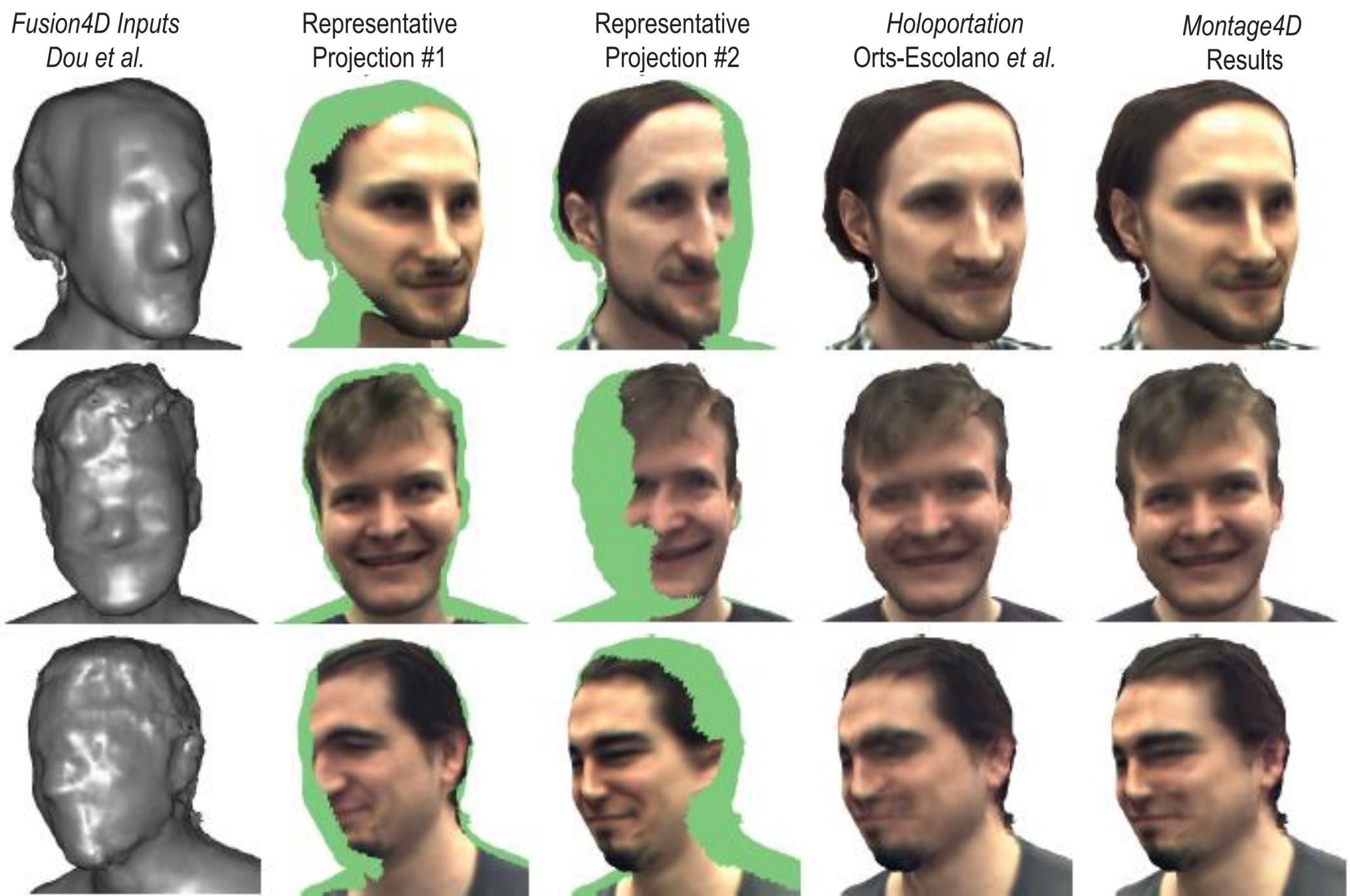
Cross-validation

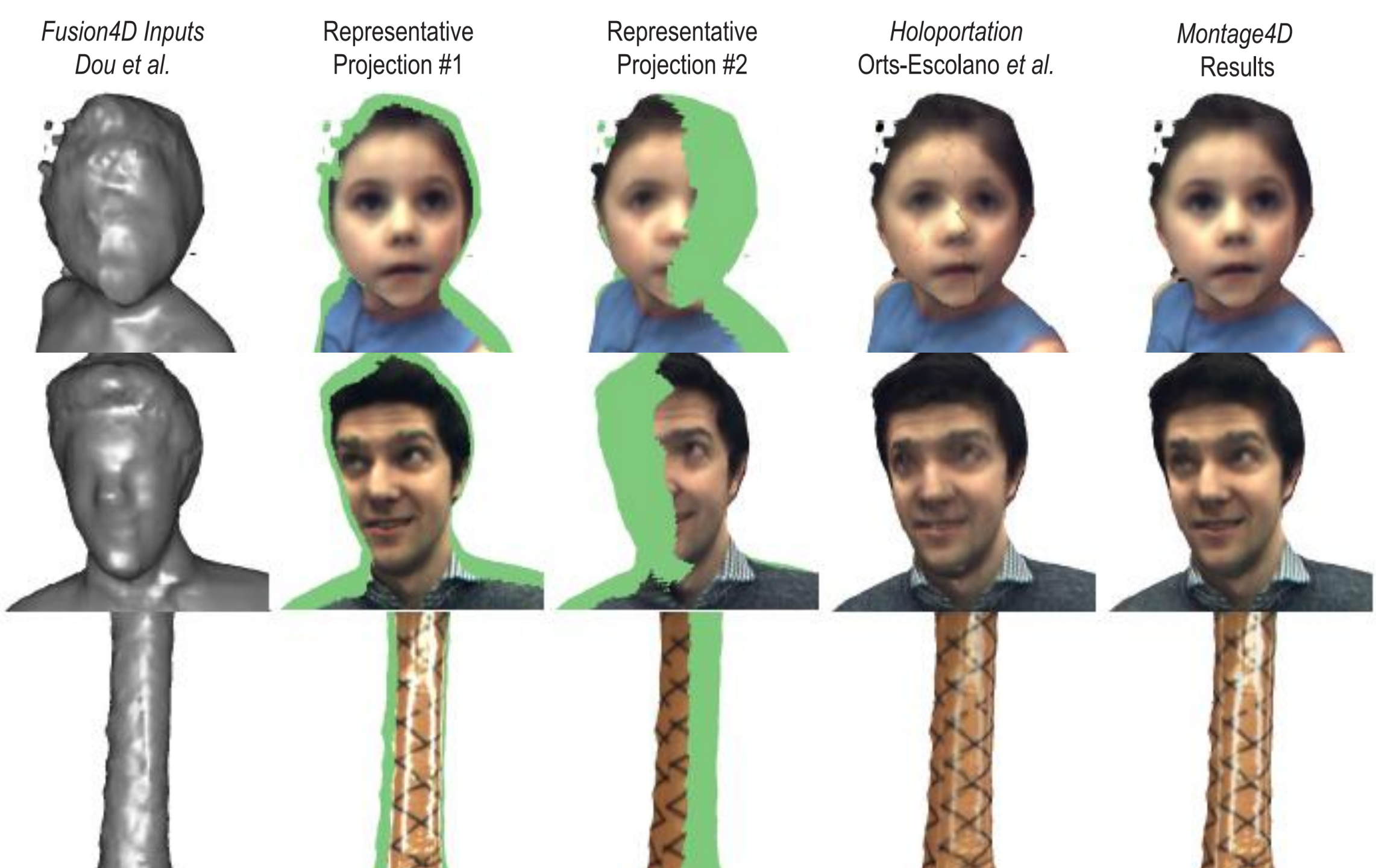
Table 1: Comparison between *Holoportation* and *Montage4D* in cross-validation experiments

Dataset	Frames	#vertices / frame	#triangles / frame	*Holoporation*				*Montage4D*			
				RMSE	SSIM	PSNR	FPS	RMSE	SSIM	PSNR	FPS
Timo	837	131K	251K	5.63%	0.9805	38.60dB	227.2	3.27%	0.9905	40.23dB	135.0
Yury	803	132K	312K	5.44%	0.9695	39.20dB	222.8	3.01%	0.9826	40.52dB	130.5
Sergio	837	215K	404K	7.74%	0.9704	29.84dB	186.8	4.21%	0.9813	30.09dB	114.3
Girl	1192	173K	367K	7.16%	0.9691	36.28dB	212.56	3.73%	0.9864	36.73dB	119.4
Julien	526	157K	339K	12.63%	0.9511	33.94dB	215.18	6.71%	0.9697	35.05dB	120.6

Montage4D achieves **better quality with over 90 FPS**

- Root mean square error (RMSE) ↓
- Structural similarity (SSIM) ↑
- Signal-to-noise ratio (PSNR) ↑


Fusion4D Inputs
Dou et al.
Representative
Projection #1
Representative
Projection #2
Holoportation
Orts-Escolano *et al.*
Montage4D
Results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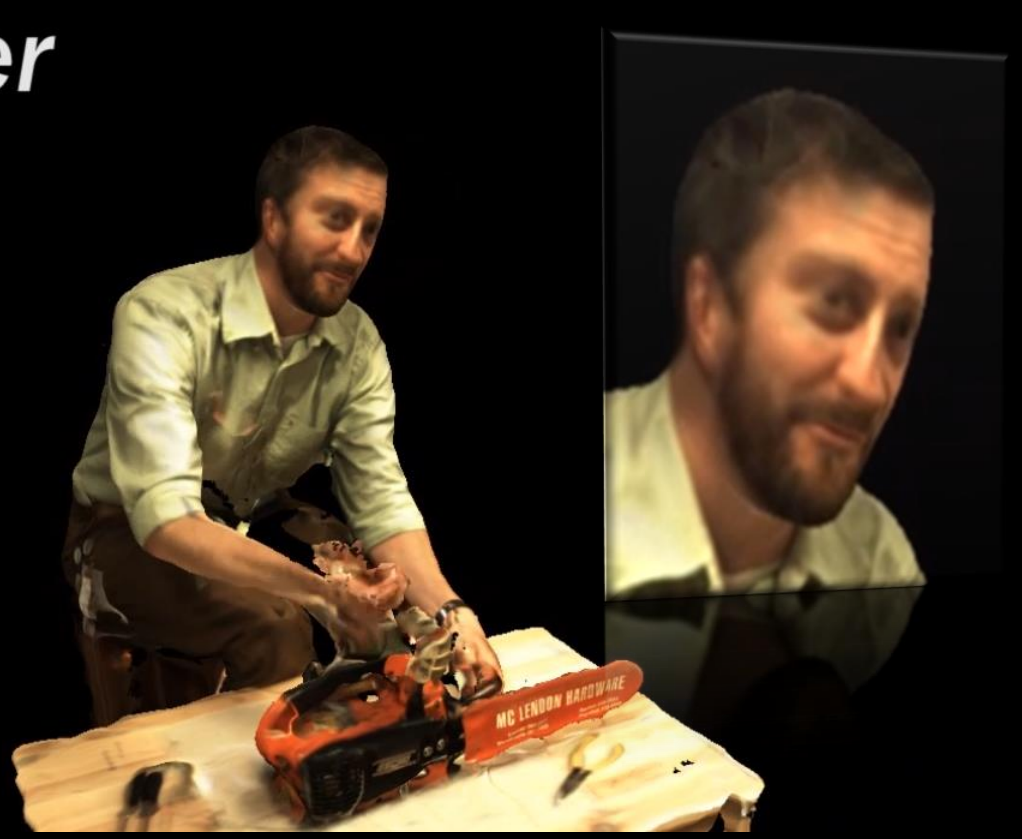

In conclusion, **Montage4D** provides a practical texturing solution for real-time 3D reconstructions. In the future, we envision that **Montage4D** is useful for **fusing the massive multi-view video data** into VR applications like remote business meeting, remote training, and broadcasting industries.

Thank you

With a Starry Night Stylization

Ruofei Du, Ming Chuang, Wayne Chang, Hugues Hoppe, and Amitabh Varshney. (2018). Montage4D: Interactive Seamless Fusion of Multiview Video Textures . In Proceedings of ACM SIGGRAPH Symposium on Interactive 3D Graphics and Games (I3D), 124-135. DOI:10.1145/3190834.3190843

Ruofei Du
ruofei@cs.umd.edu

Ming Chuang
mingchuang82@gmail.com

Wayne Chang
wechang@microsoft.com

Hugues Hoppe
hhoppe@gmail.com

Amitabh Varshney
varshney@cs.umd.edu