NEURAL INFORMATION PROCESSING SYSTEMS

北京航空航天大學 BEIHANG UNIVERSITY

TGA: True-to-Geometry Avatar Dynamic Reconstruction

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Why **True-to-Geometry** Dynamic Avatars?

- Realistic avatars require accurate **geometry** under motion and expression. We aim for geometry-accurate reconstruction, not just photorealistic rendering.

Comparison of related works

	Gaussian Avatars	Gaussian HeadAvatar	Topo4D	SurFHead	NPGA	Scaffold Avatar	TGA(Ours)
Realistic rendering	√	√	√	√	√	√	√
Reenactment	√	√	×	√	√	√	√
Mesh reconstruction	×	×	√	√(But by depth fusion)	×	×	√

Key Ideas

Our goal is to reconstruct dynamic head avatars with **geometry-accurate surfaces** and **efficient mesh extraction** under motion and expression changes.

- To achieve this, we introduce a Perspective-Aware Gaussian Transformation that integrates Jacobian-guided deformation and homogeneous projection for true-to-geometry Gaussian modeling.
- We then construct a Dynamic BVH Tree that updates per frame through branch rotations and pivoting, adaptively filtering hopping points representing dynamic regions.
- These hopping points are incrementally triangulated via Marching Tetrahedra, enabling fast and temporally consistent mesh reconstruction.

TGA Framework Overview

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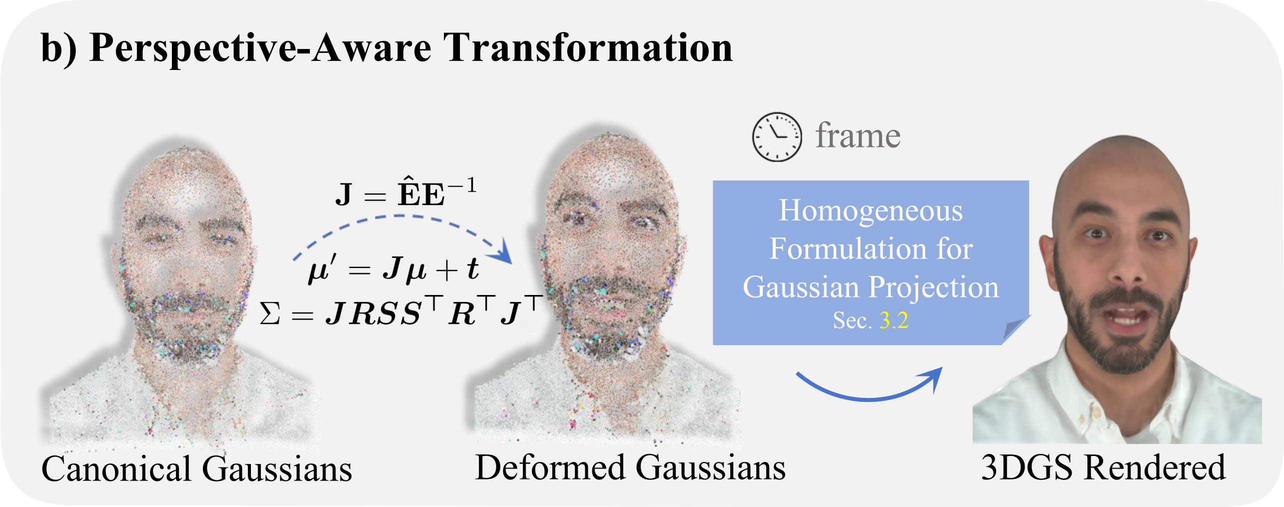
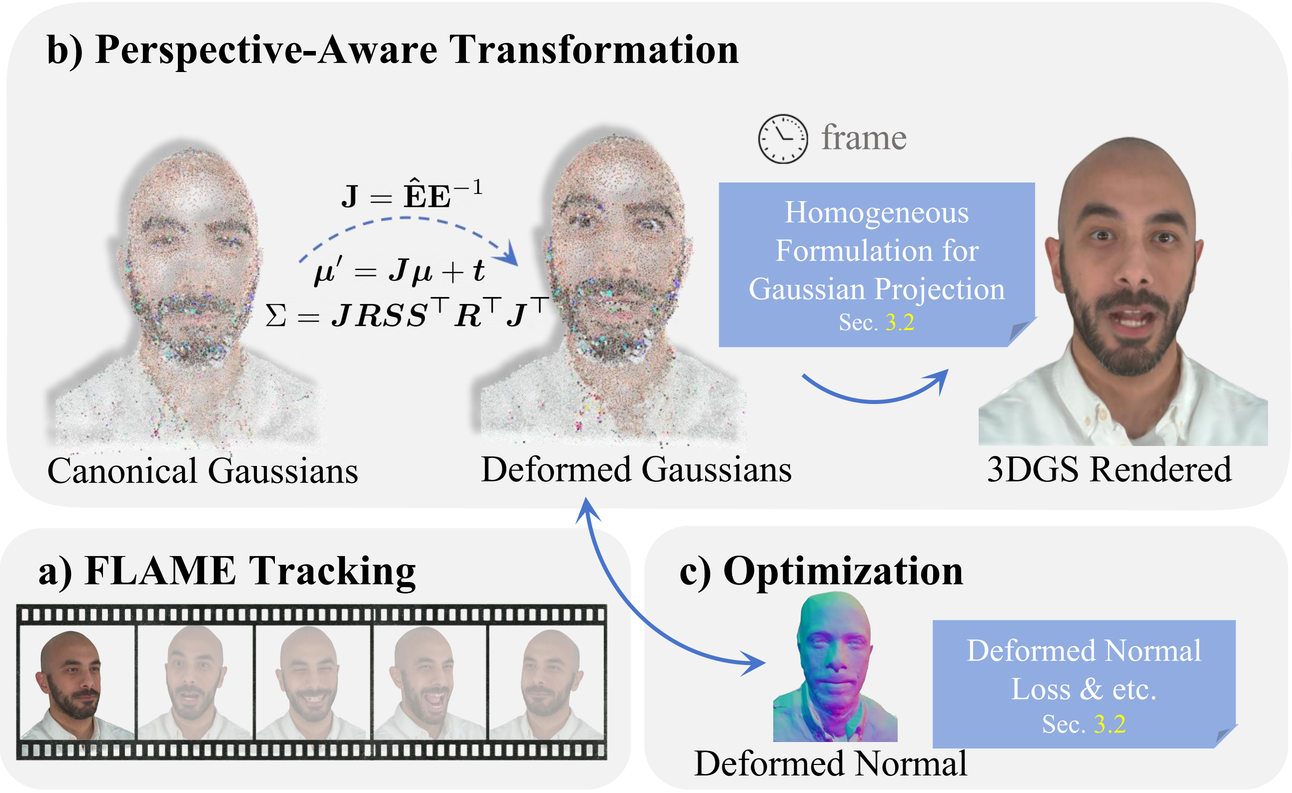
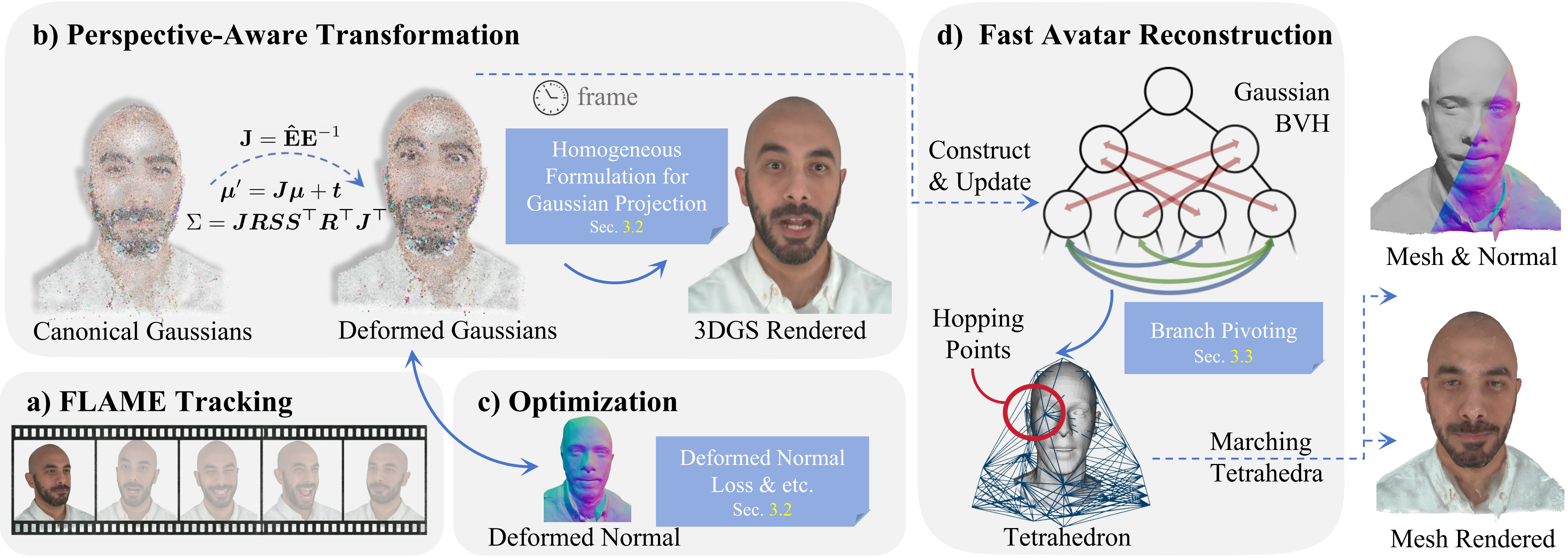


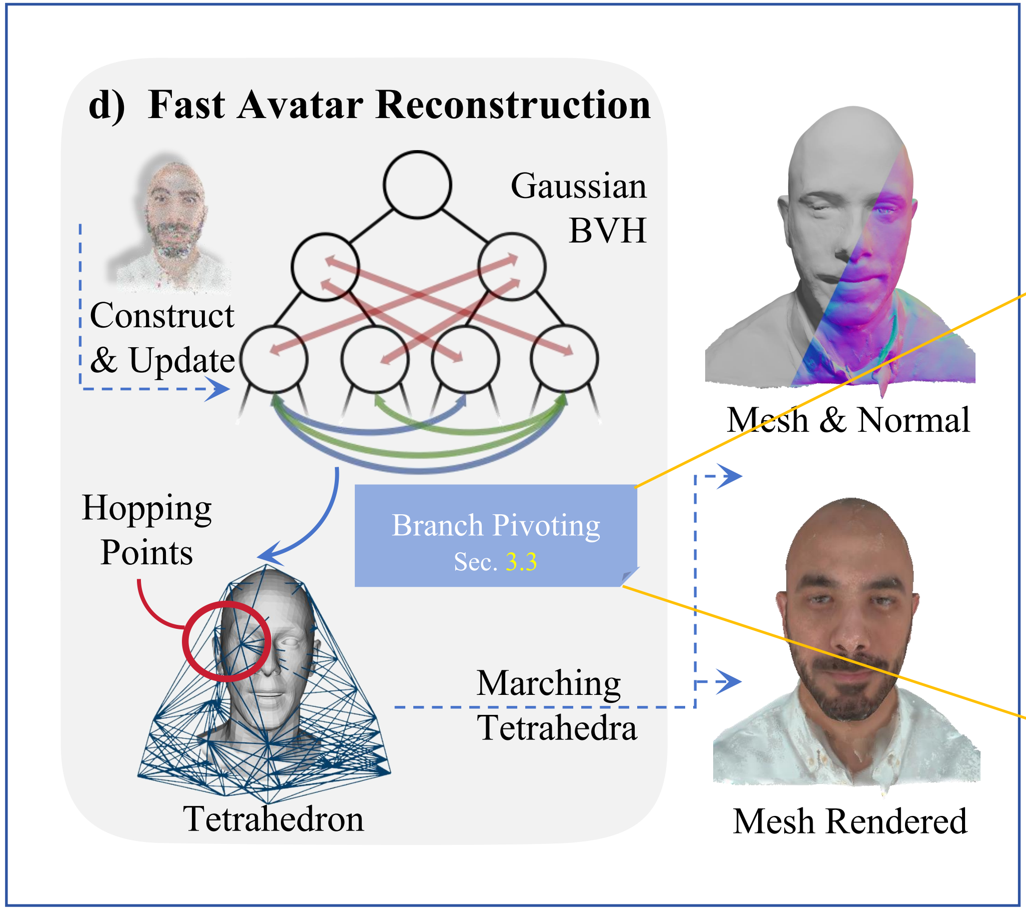
TGA Framework Overview

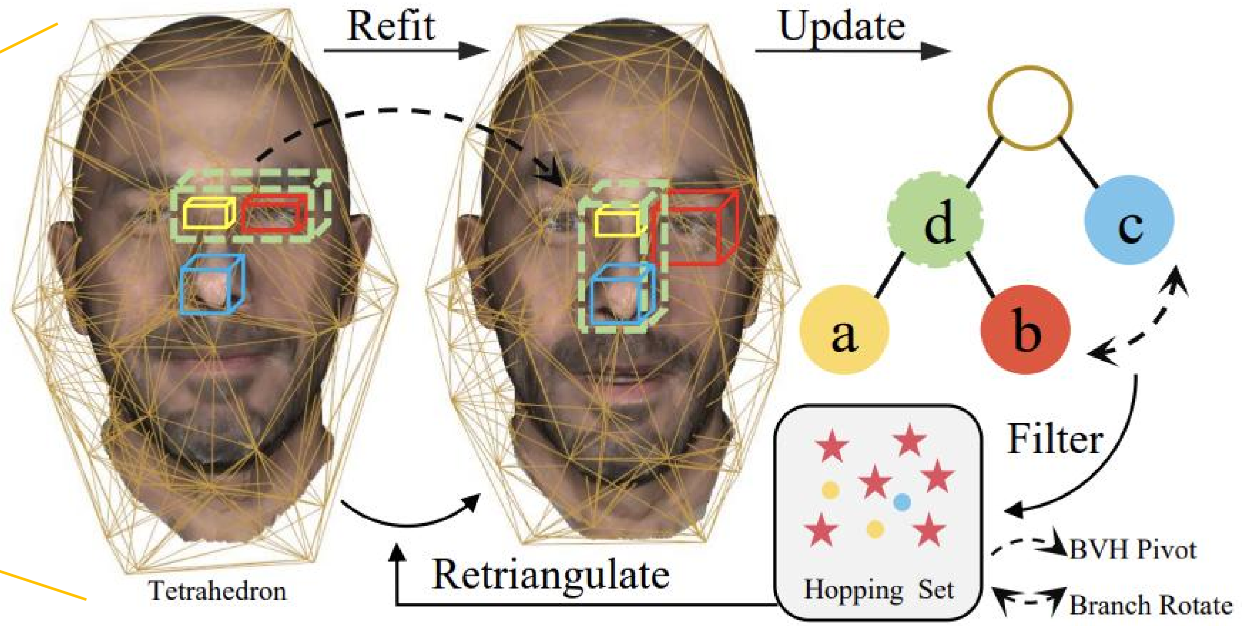


TGA Framework Overview



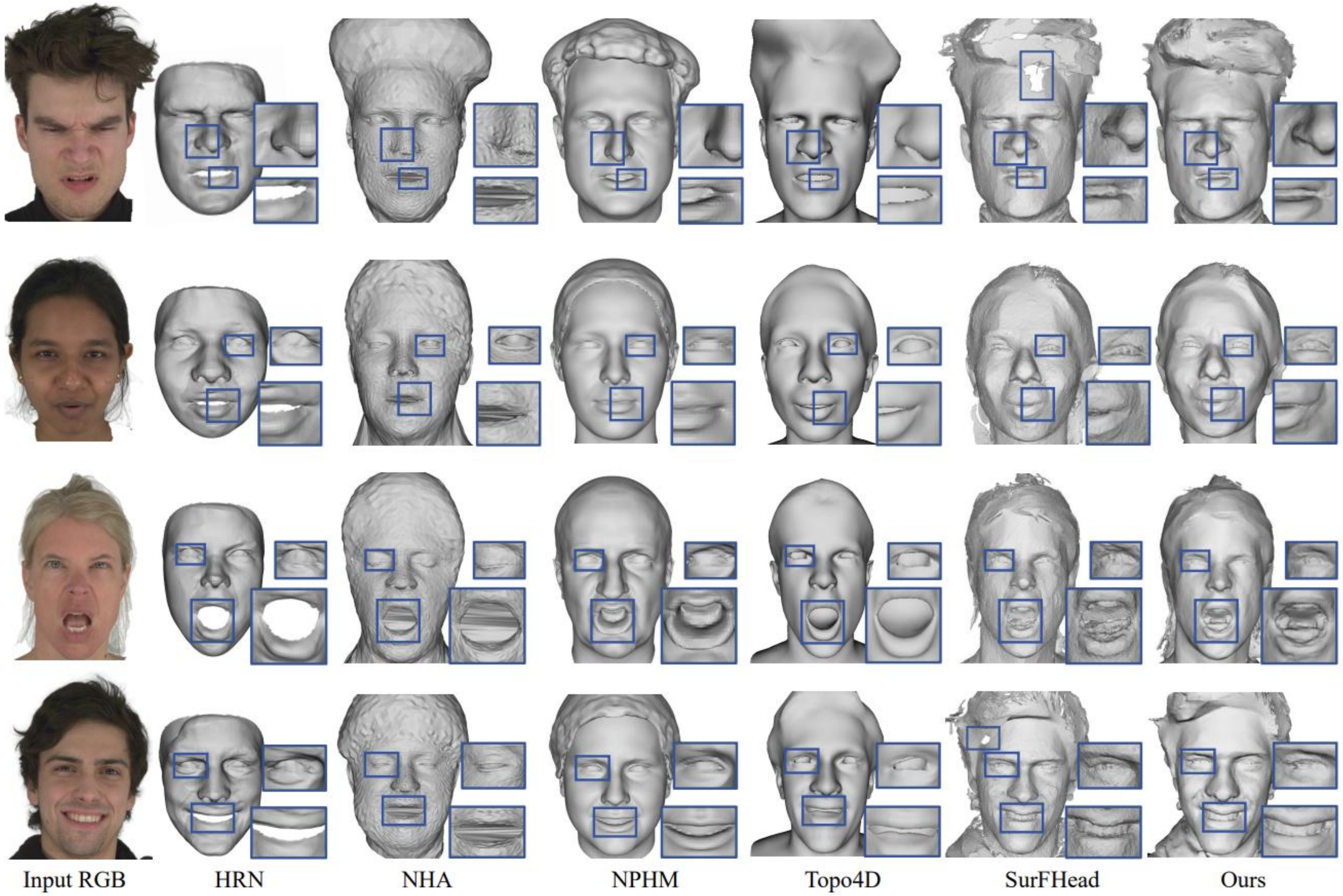
Incremental BVH Tree Pivoting (Sec 3.3)

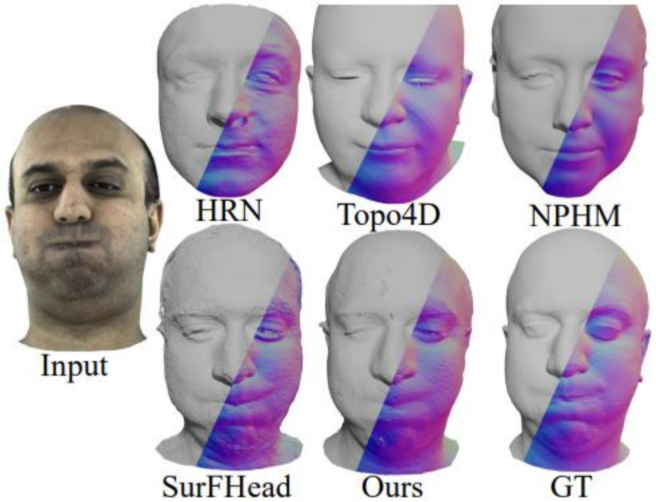




Results: geometry

- TGA achieves best Chamfer and Normal errors among all baselines.

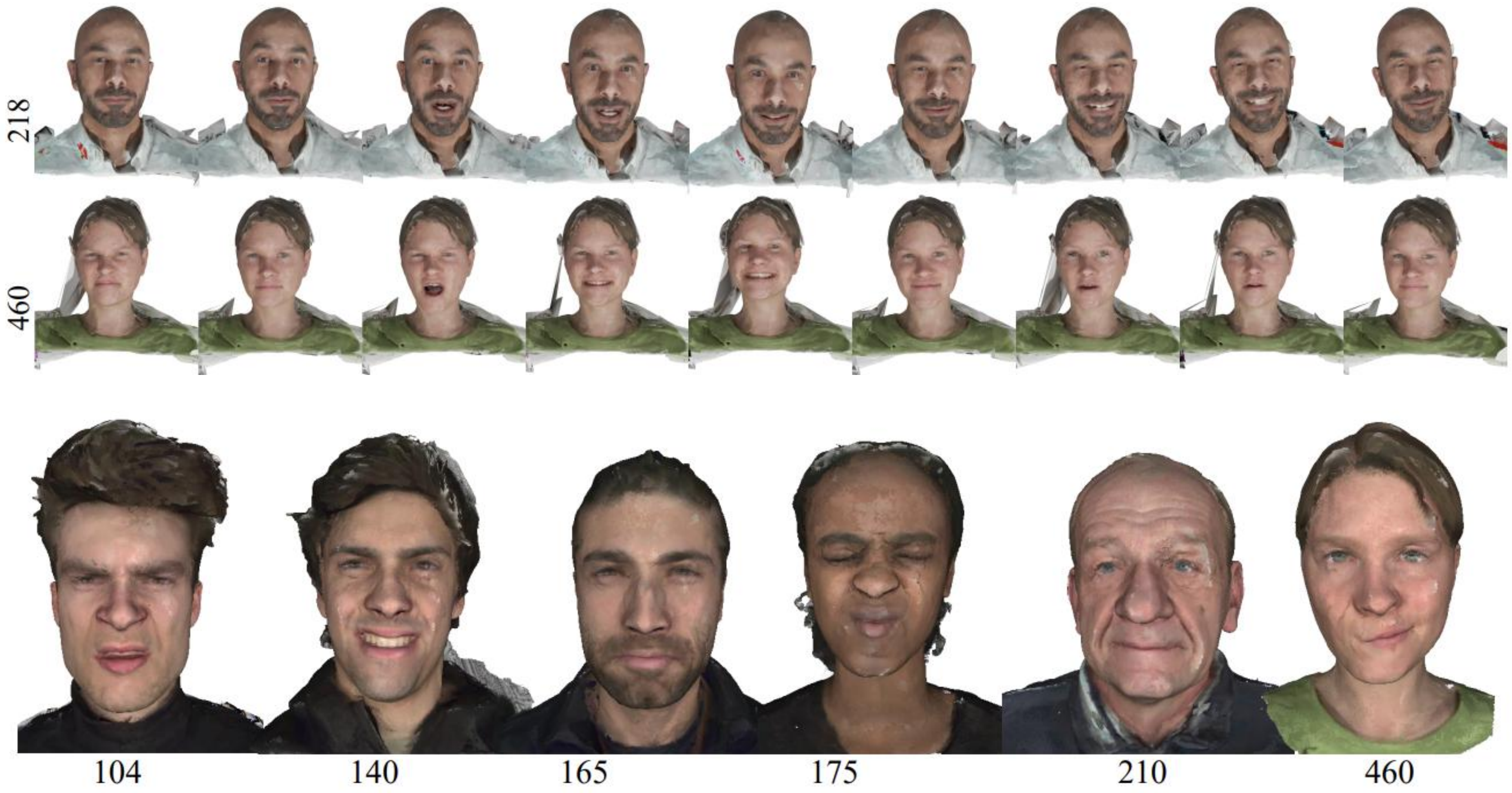




Method	L_1-CD↓	MAE↓	Recall@2.5mm↑
HRN [67]	2.64	22.3	0.698
3DDFA [68]	4.35	22.9	0.649
NHA [42]	6.02	28.9	0.462
NPHM [24]	3.35	20.5	0.764
SF [4]	2.50	24.8	0.751
Topo4D [54]	2.33	19.3	0.772
Ours	**2.16**	**17.7**	**0.802**

Results: mesh-rendering

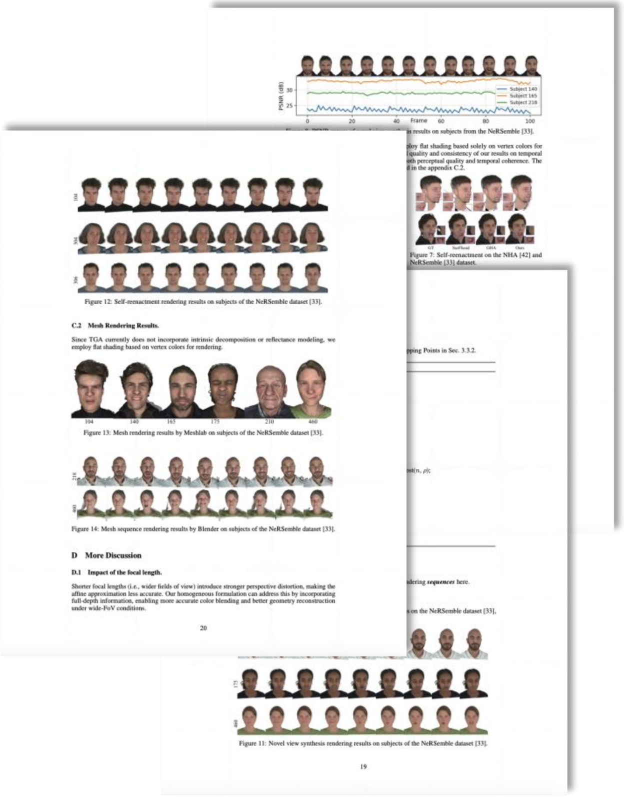
- Since TGA currently does not incorporate intrinsic decomposition or reflectance modeling, we employ flat shading based on vertex colors for rendering.

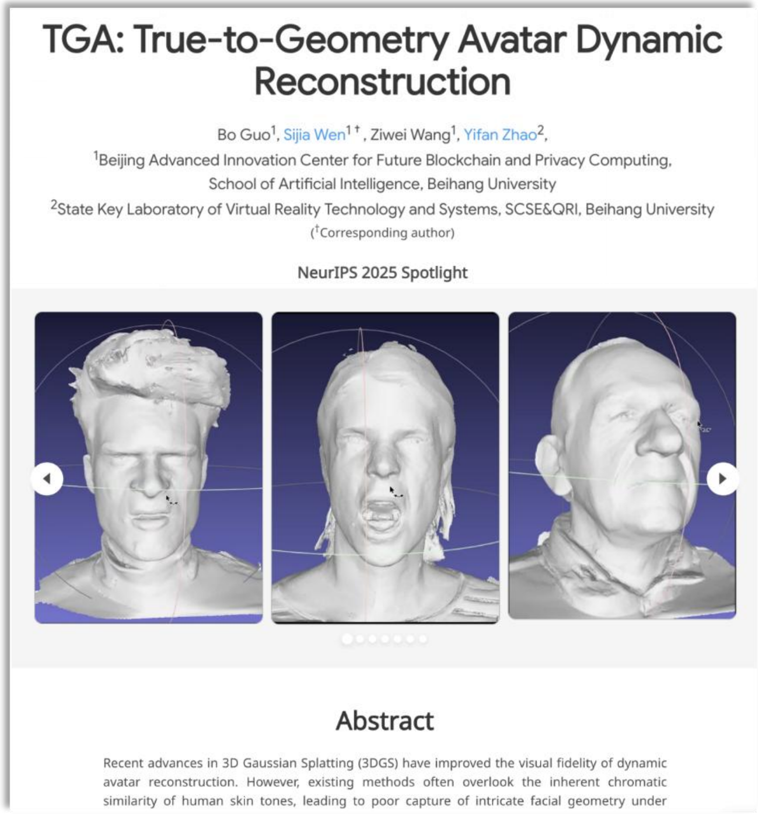


Results: 3dgs-rendering (novel view synthesis)

Results

- More detailed results can be found in paper and project website.





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