

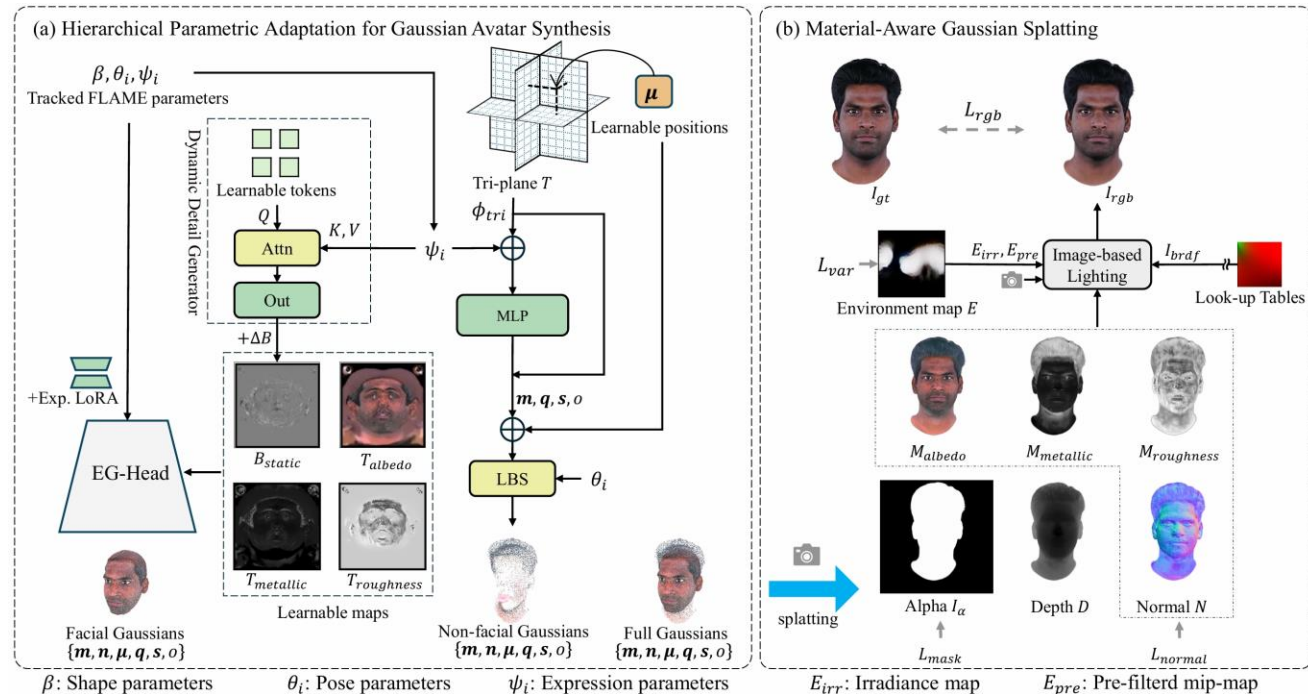
Learning Storage-Efficient 3D Gaussian Head Avatars from Monocular Videos via Parametric Adaptation and Material Decomposition

Guohao LI, Hongyu YANG, Di HUANG, Yunhong WANG

Frontiers of Computer Science, DOI: [10.1007/s11704-025-50214-5](https://doi.org/10.1007/s11704-025-50214-5)

Problems & Ideas

- Problems of existing approaches:
 - Suffer from prohibitive storage requirements from per-primitive animation parameters and spherical harmonics (SH) coefficients.
 - compromise facial fidelity due to insufficient dynamic detail modeling.
- Ideas: Replacing SH with PBR rendering and utilizing 3DMM geometry cues.



Overview of the proposed framework. Left: Hierarchical Parametric Adaptation with LoRA and DDG; Right: Material-Aware Gaussian Splatting, a physically based rendering pipeline, uses a deferred shading workflow.

Main Contributions

- Contributions:
 - A hierarchical parametric adaptation strategy combining Low-Rank Adaptation (LoRA) of 3DMM bases and a Dynamic Detail Generator (DDG), enabling storage-efficient animation;
 - A material-aware Gaussian Splatting paradigm to replaces the 48 dimensional SH with a compact 5 dimensional PBR material representation, enabling photorealistic relighting;
 - A 3DMM-aware material initialization method to accelerate convergence.

| Method | Storage ↓ | FPS@512 ² ↑ | PSNR ↑ |
|------------|-----------|------------------------|--------|
| INSTA [13] | 24 MB | 20 FPS | 27.33 |
| GBS [21] | 200 MB | 120 FPS | 30.30 |
| Ours | 10 MB | 60 FPS | 30.70 |

our approach achieves state-of-the-art reconstruction quality with an extremely compact model size (<10 MB) and real-time rendering at 60 FPS.