

# ArchitectHead: Continuous Level of Detail Control for 3D Gaussian Head Avatars

Peizhi Yan\*, Rabab Ward, Qiang Tang, Shan Du

University of British Columbia, Canada

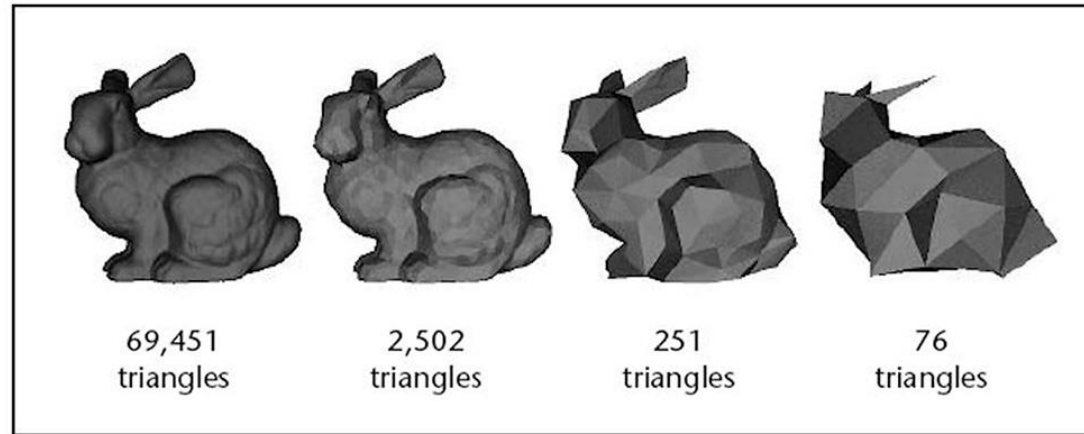
(\*presenter)

Project Homepage



# Motivation

In 3D meshes, **LOD control** is a well-established technique **to balance Quality and Efficiency**.



## Challenge in 3DGS:

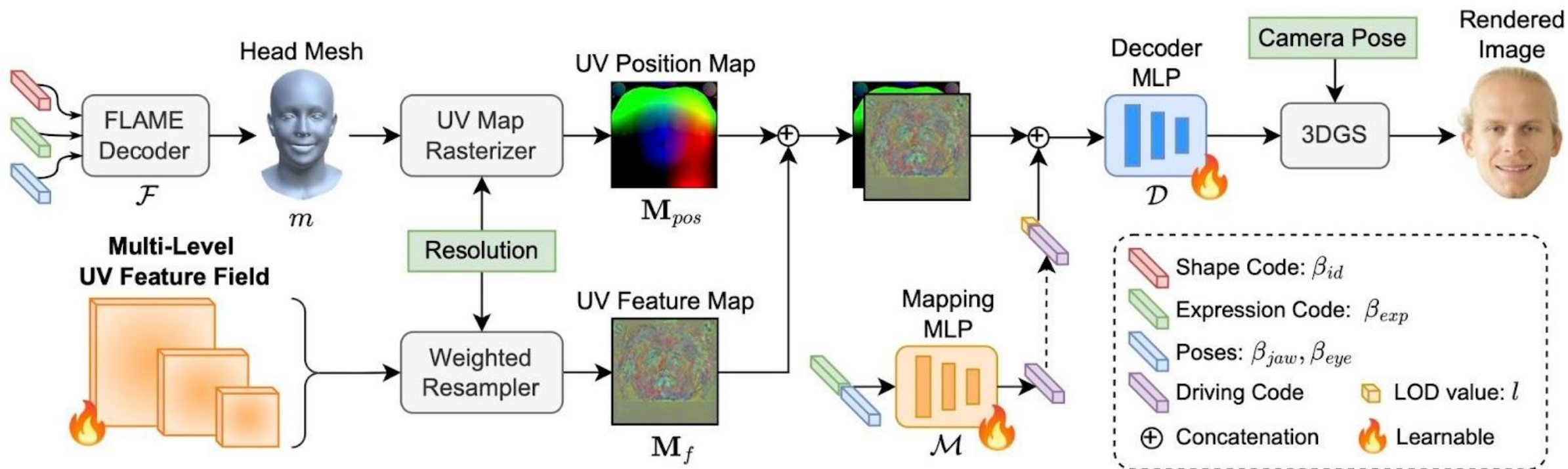
- Unlike a 3D mesh, where vertices are connected and can be simplified using standard decimation algorithms, **3D Gaussians are unstructured, ellipsoid-like primitives**.
- Even nearby Gaussians might have completely different attributes (e.g., scales, rotations, and colors). Therefore, **we cannot simply “merge” nearby Gaussians** to reduce the point count without causing massive visual artifacts.

# Method: ArchitectHead

## Key Idea:

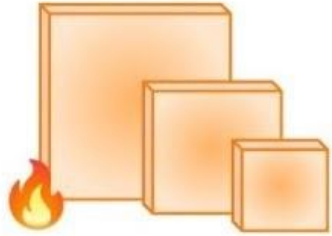
ArchitectHead introduces the first 3D Gaussian head avatar framework capable of real-time, continuous Level of Detail (LOD) control **by treating Gaussian density like 2D image resolution.**

# Method: ArchitectHead



# Sampling UV Feature Map

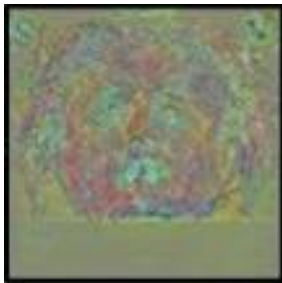
Multi-Level  
UV Feature Field



$$\mathcal{U} = \{M_f^{S_1}, \dots, M_f^{S_N}\}$$

Weighted  
Resampling

**New Resolution:**  $S = S_{\max} - l (S_{\max} - S_{\min})$      **LOD:**  $0 \leq l \leq 1.0$



UV Feature Map

$$M_f = \sum_{i=1}^N w_i * \mathcal{I}(M_f^{S_i}, S)$$

# Training

**Loss function:**  $\mathcal{L} = \underbrace{\mathcal{L}_{rgb} + \lambda_{lpips}\mathcal{L}_{lpips}}_{\text{Reconstruction Terms}} + \underbrace{\lambda_{\mu}\mathcal{L}_{\mu} + \lambda_s(1 - 0.5l)\mathcal{L}_s}_{\text{Regularization Terms}}$

**Stage 1:** Render with the highest LOD (LOD = 0)

**Stage 2:** Render with 5 LODs ranging from 0 to 1.0.

# Results: Self-Reenactment

Ground Truth



GaussianAvatars  
(CVPR'24)



FlashAvatar  
(CVPR'24)



GaussianDejavu  
(WACV'25)



ArchitectHead  
(Ours)



Ground Truth



GaussianAvatars  
(CVPR'24)



FlashAvatar  
(CVPR'24)



GaussianDejavu  
(WACV'25)



ArchitectHead  
(Ours)



# Results: Cross-Reenactment

Driving Frame



ArchitectHead  
(Ours)



GaussianAvatars  
(CVPR'24)



FlashAvatar  
(CVPR'24)



GaussianDejavu  
(WACV'25)



RGBAvatar  
(CVPR'25)



# Demo: Continuous LOD Control

FLAME

Expression Coefficients

0.000	0
0.000	1
0.000	2
0.000	3
0.000	4
0.000	5
0.000	6
0.000	7
0.000	8
0.000	9

Jaw

0.040	Up/Down
0.000	Left/Right

Eyes

0.000	Left/Right
-------	------------

Reset

Camera

Rotate and Translate

-0.013	Left/Right
-0.052	Up/Down
0.850	Distance

Other

20.000	FoV
--------	-----

Avatar Selector



Render

LOD

0.000	LOD
-------	-----



THE UNIVERSITY  
OF BRITISH COLUMBIA

# Thanks!

Project Homepage

