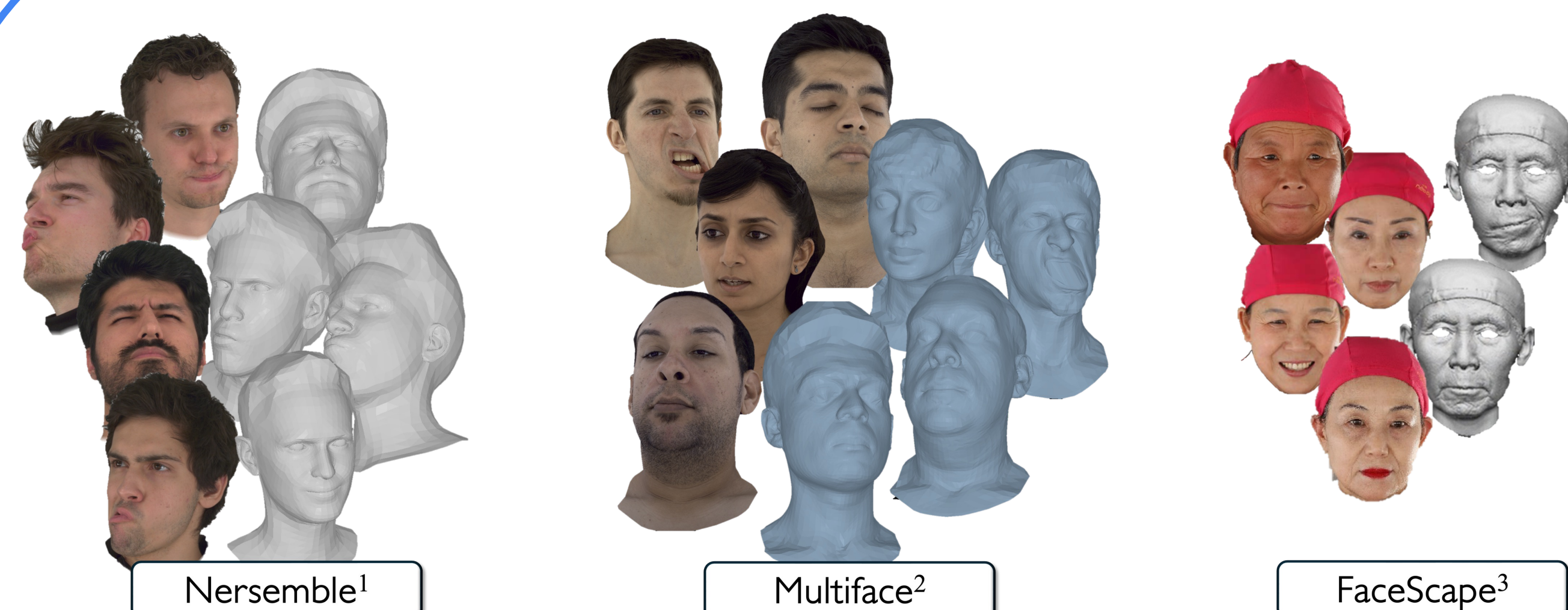




# SynShot: Synthetic Prior for Few-Shot Drivable Head Avatar Inversion

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## Motivation



### Challenges

- I. Controllable 3D generative models need diverse image-mesh pairs, which are scarce.
- II. Real data use is limited by privacy laws (e.g., GDPR).
- III. Monocular avatar models lack strong priors and often overfit, limiting generalization.

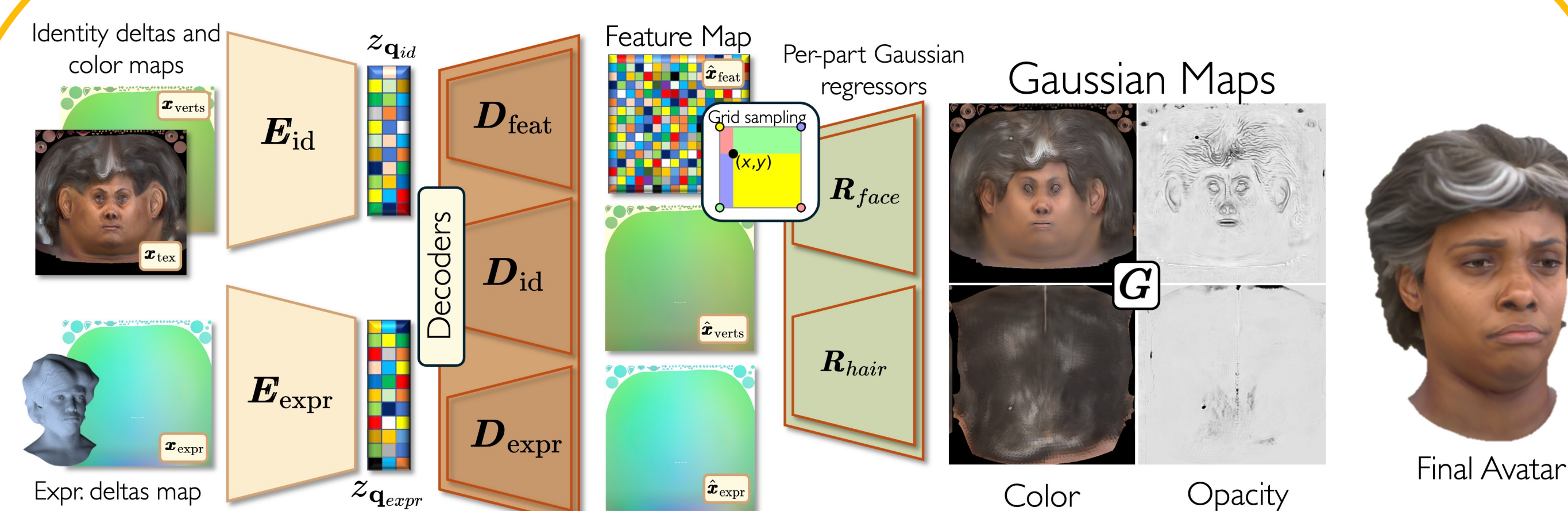
### Solution

To address those challenges, we propose a method that learns a prior from a large synthetic dataset of diverse heads. Given a few input images, it fine-tunes this prior to generate a photorealistic avatar that generalizes to new expressions and views.



1) Kirschstein *et al.* NeRSemble: Multi-View Radiance Field Reconstruction of Human Heads  
2) Wu *et al.* Multiface: A Dataset for Neural Face Rendering  
3) Zhu *et al.* FaceScape: 3D Facial Dataset and Benchmark for Single-View 3D Face Reconstruction

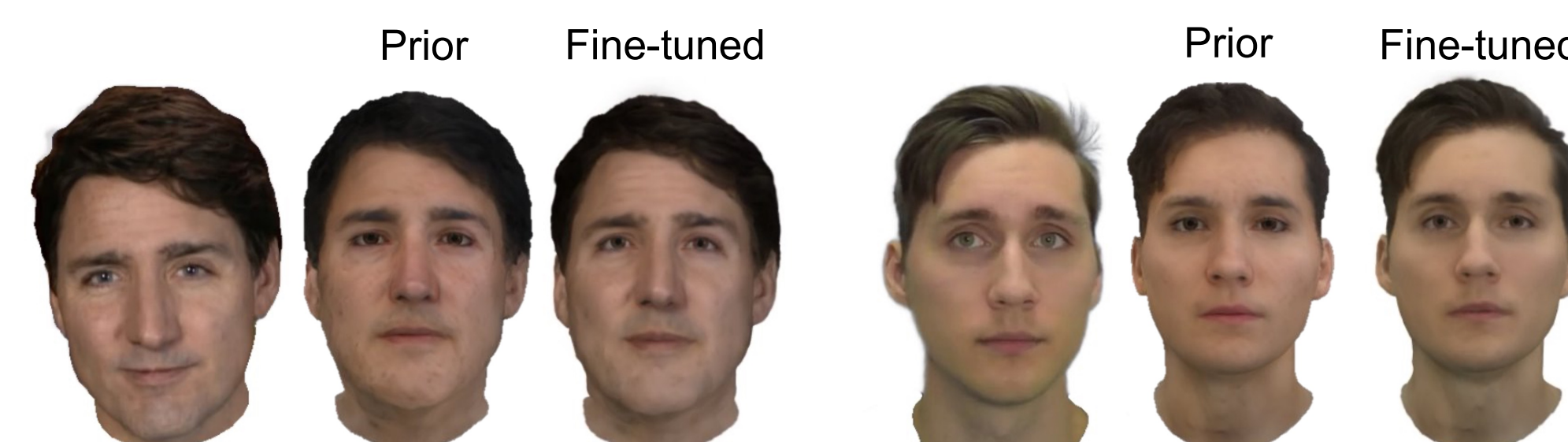
## Synthetic Prior



The prior network uses a VQ-VAE generative framework to predict feature maps, which are later bilinearly sampled and used as conditioning inputs for per-part (face, hair) regressors of Gaussian primitives.

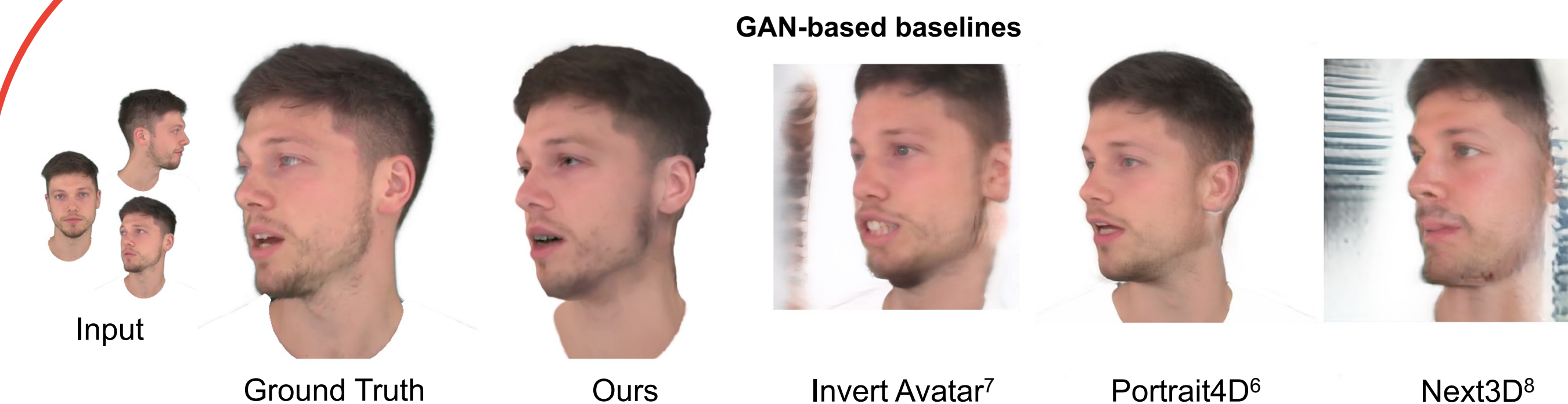


Our latent space for expressions and identity is represented by a smooth manifold.

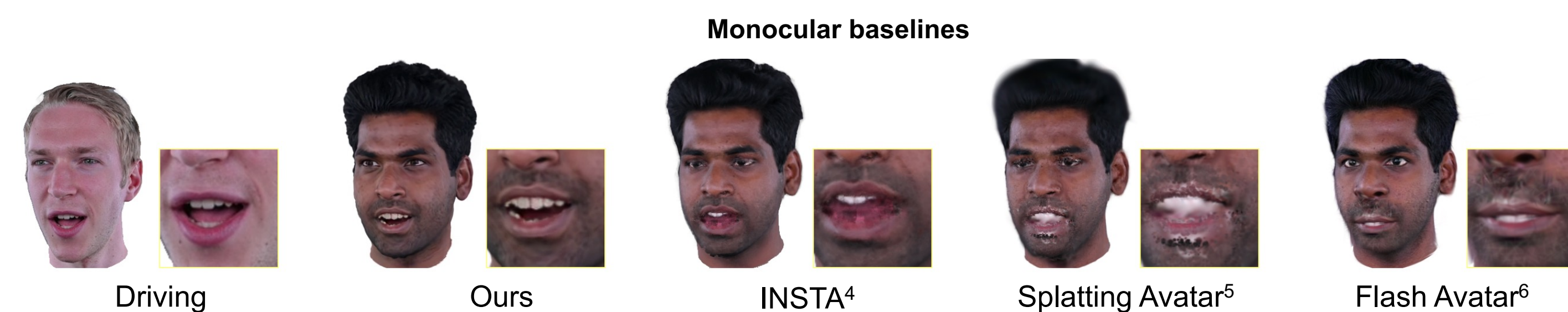


To bridge the sim-to-real gap, we designed an optimization-based refinement technique for our prior network, like pivotal tuning.

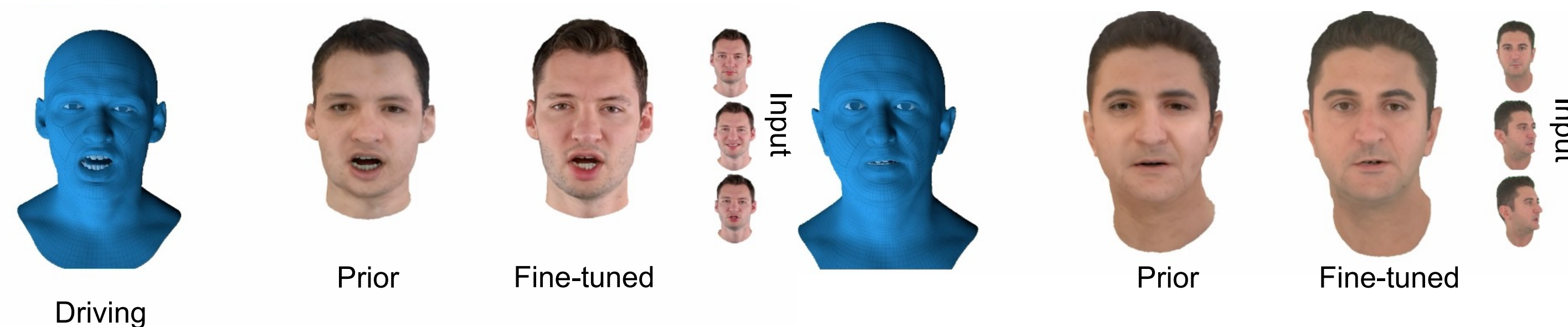
## Few-shot Inversion



SynShot outperform existing GAN-based methods especially in novel-view consistency.



Synthetic prior significantly boosts cross-reenactment over monocular methods.



We can bridge the gap between synthetics and real data.



4) Zielonka *et al.* Instant Volumetric Head Avatars  
5) Xiang *et al.* FlashAvatar: High-fidelity Head Avatar with Efficient Gaussian Embedding  
6) Zhijiang *et al.* SplattingAvatar: Realistic Real-Time Human Avatars with Mesh-Embedded Gaussian Splatting  
7) Zhao *et al.* InvertAvatar: Incremental GAN Inversion for Generalized Head Avatars  
8) Deng *et al.* Portrait4D: Learning One-Shot 4D Head Avatar Synthesis using Synthetic Data  
9) Sun *et al.* Next3D: Generative Neural Texture Rasterization for 3D-Aware Head Avatars