腾讯优图

Learning Neural Proto-face Field for Disentangled 3D Face Modeling In the Wild

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TUE-AM-037

Existing 3D Face Modeling Methods

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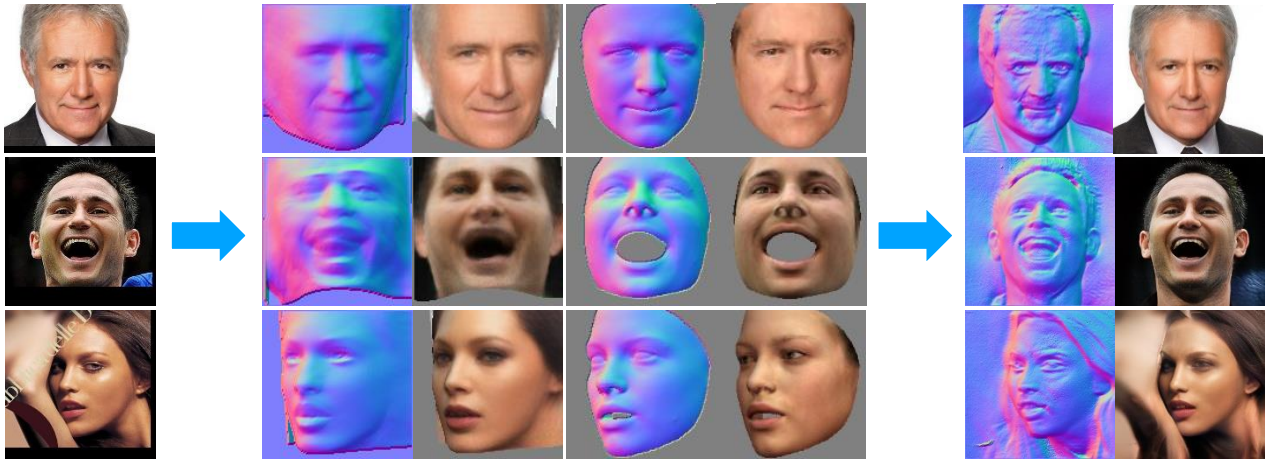
Graphics-renderer-based method



LAP [1] D3DFR [2] Ours

Our method recovers more high-quality and photo-realistic 3d face

[1] Zhang Z, Ge Y, Chen R, et al. Learning to Aggregate and Personalize 3D Face from In-the-Wild Photo Collection[C]//Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition. 2021: 14214-14224.

[2] Deng Y, Yang J, Chen D, et al. Disentangled and controllable face image generation via 3d imitative-contrastive learning[C]//Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition. 2020: 5154-5163.

Existing 3D Face Modeling Methods

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Neural Rendering Method, e.g., NeRF-based Generative models

Reconstruction

Deformation

EG3D [3] + PTI [4]

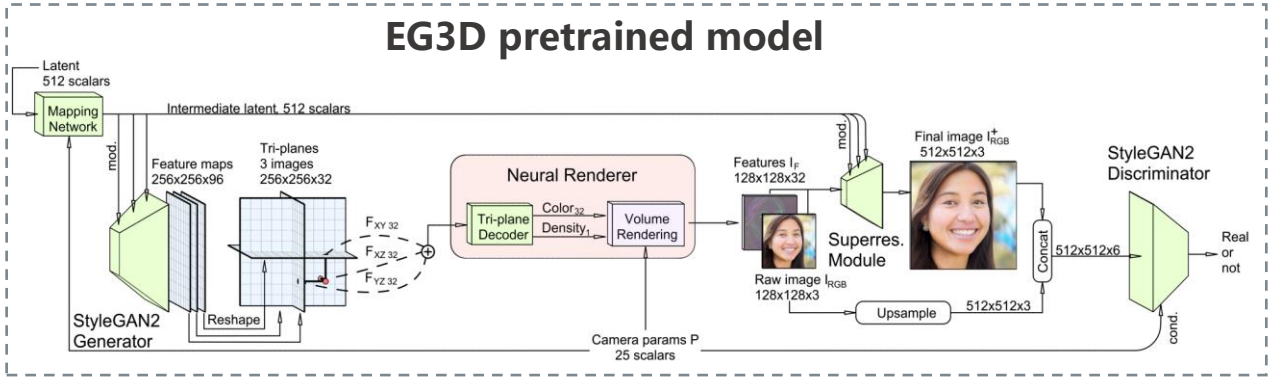
Ours

Our method is **more robust** to challenging conditions, and is able to perform **disentangled face deformation** in a controllable way.

[3] Chan E R, Lin C Z, Chan M A, et al. Efficient geometry-aware 3D generative adversarial networks[C]//Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition. 2022: 16123-16133.

[4] Roich D, Mokady R, Bermano A H, et al. Pivotal tuning for latent-based editing of real images[J]. ACM Transactions on Graphics (TOG), 2022, 42(1): 1-13.

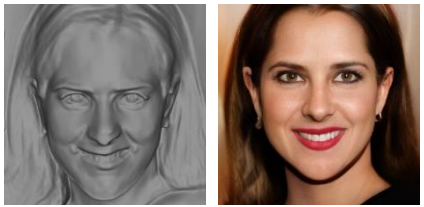
Preliminary



Style inversion

pose

\+ Pivotal tuning (PTI)



[3] Chan E R, Lin C Z, Chan M A, et al. Efficient geometry-aware 3D generative adversarial networks[C]//Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition. 2022: 16123-16133.

[4] Roich D, Mokady R, Bermano A H, et al. Pivotal tuning for latent-based editing of real images[J]. ACM Transactions on Graphics (TOG), 2022, 42(1): 1-13.

Motivation & Solution

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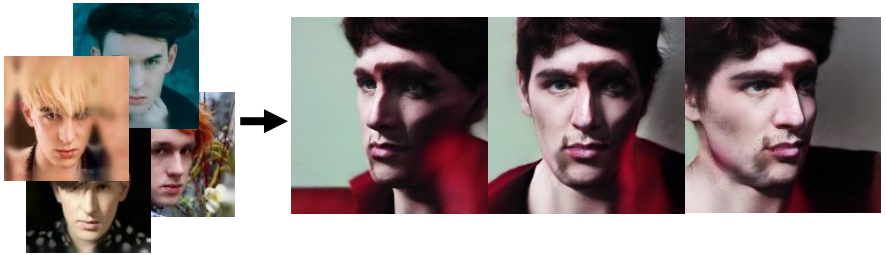
Neural rendering methods are **sensitive to large pose, extreme appearance or shadow**

Distortion

Shape ambiguity



We use photo collection to provide **consistent multi-image prior** for robust 3D face modeling

Summary of our approach

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Neural proto-face field learning

1. Aggregating a 3D-consistent face shape from a photo collection.

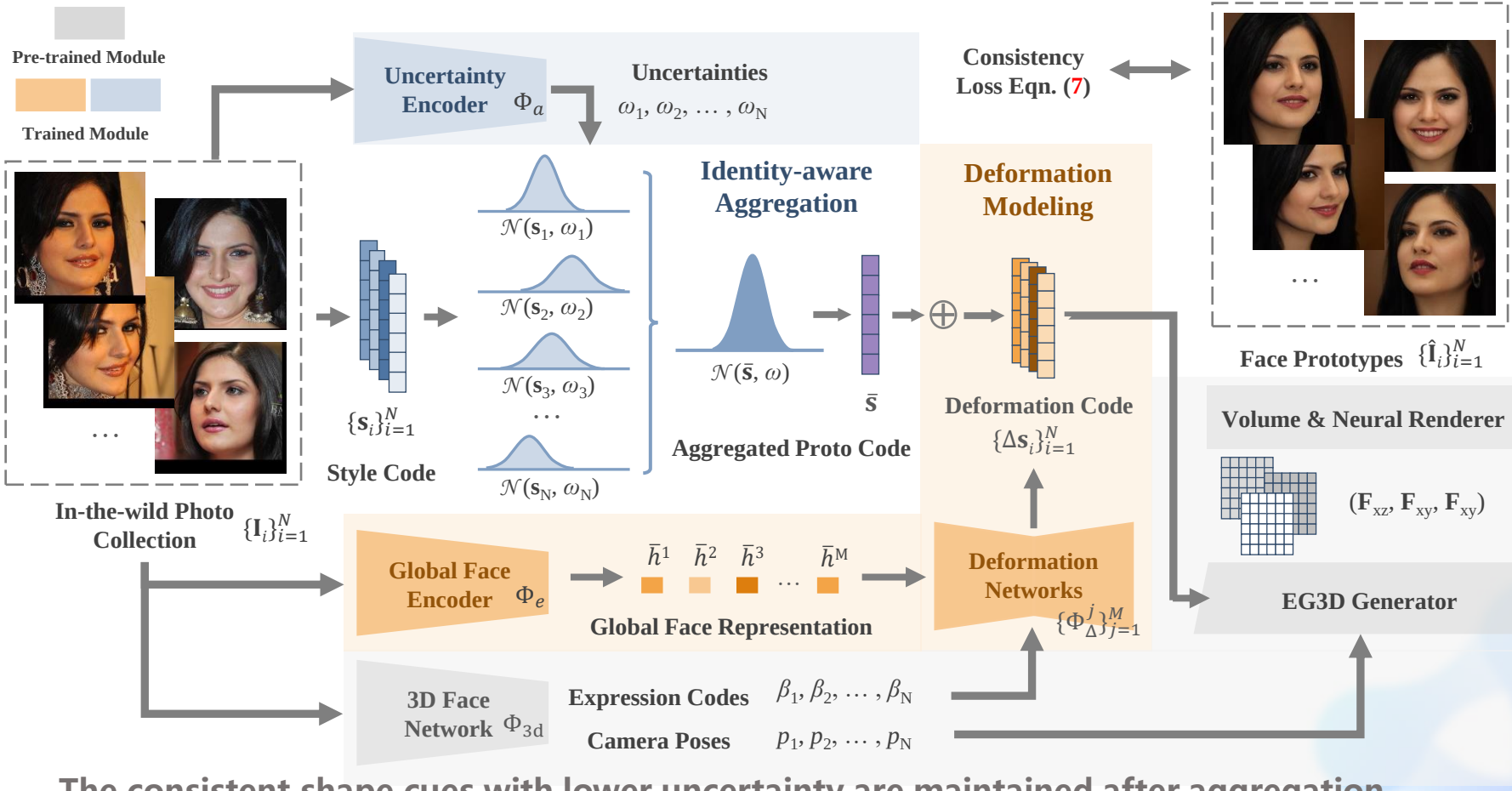
2. Disentangling the deformation and identity of face prototype.

Neural proto-face field fitting

1. Warming up the neural proto-face field based on the photo collection to avoid overfitting.

2. Fitting one target image to recover personalized details.

Approach



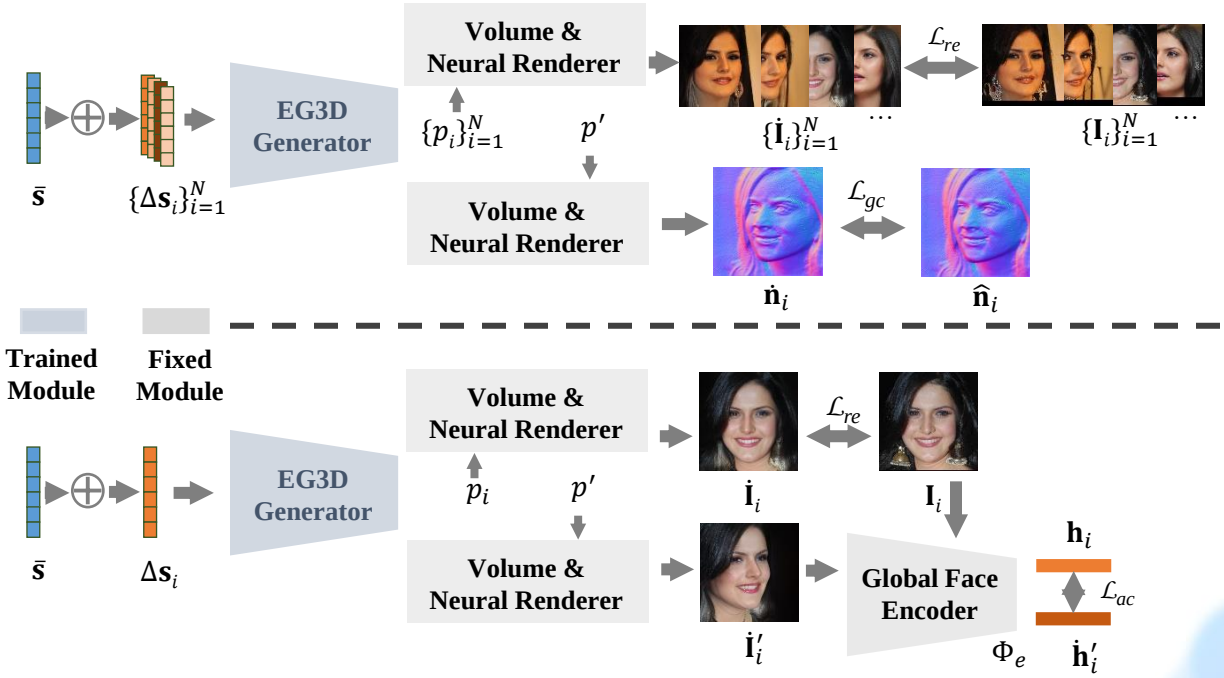
The consistent shape cues with lower uncertainty are maintained after aggregation

Approach

Neural proto-face field fitting

1. Warming up the neural proto-face field generator based on the image set and geometry consistency loss to avoid overfitting.

2. Fitting one target image under reconstruction loss and appearance consistency.



Ablation study: the deformation modeling

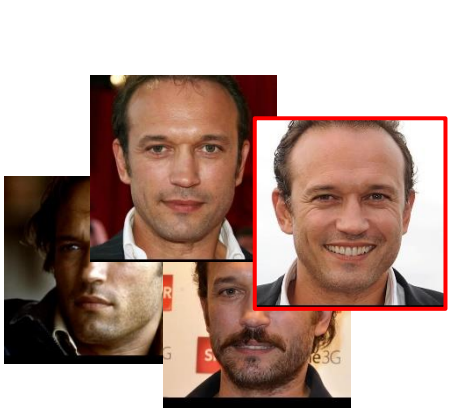
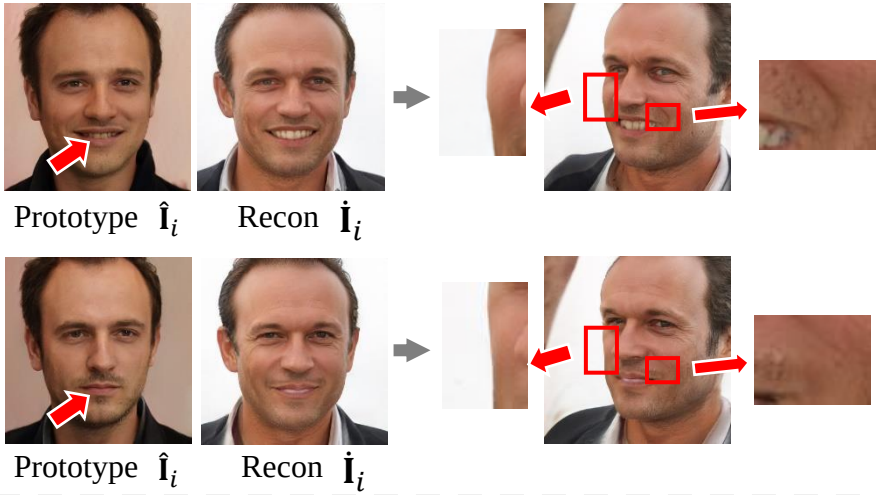
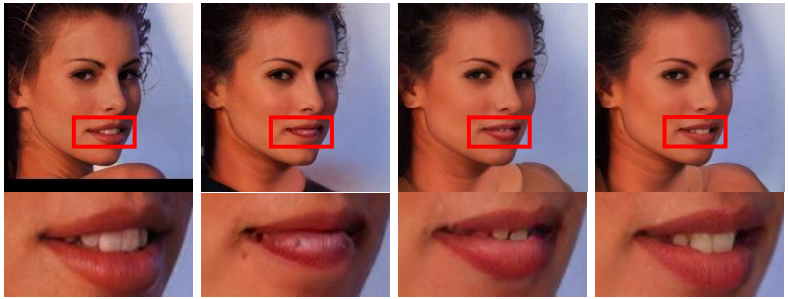


Photo Collection

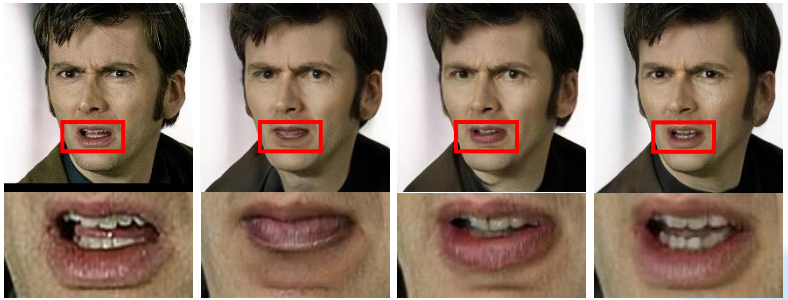
with Deformation

w/o Deformation



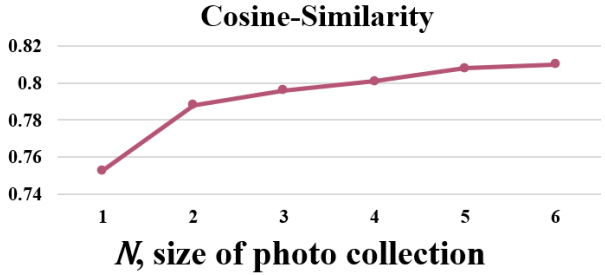


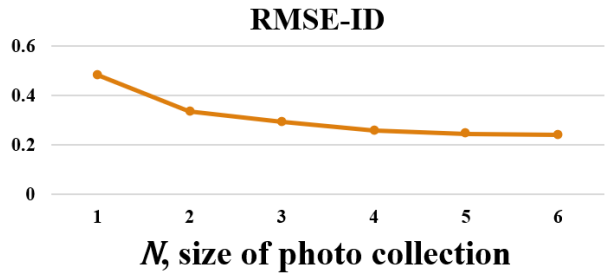
Target | w/o deformation | w/o $\bar{\mathbf{h}}$ | Ours



Target | w/o deformation | w/o $\bar{\mathbf{h}}$ | Ours

Ablation study: photo collection & fitting





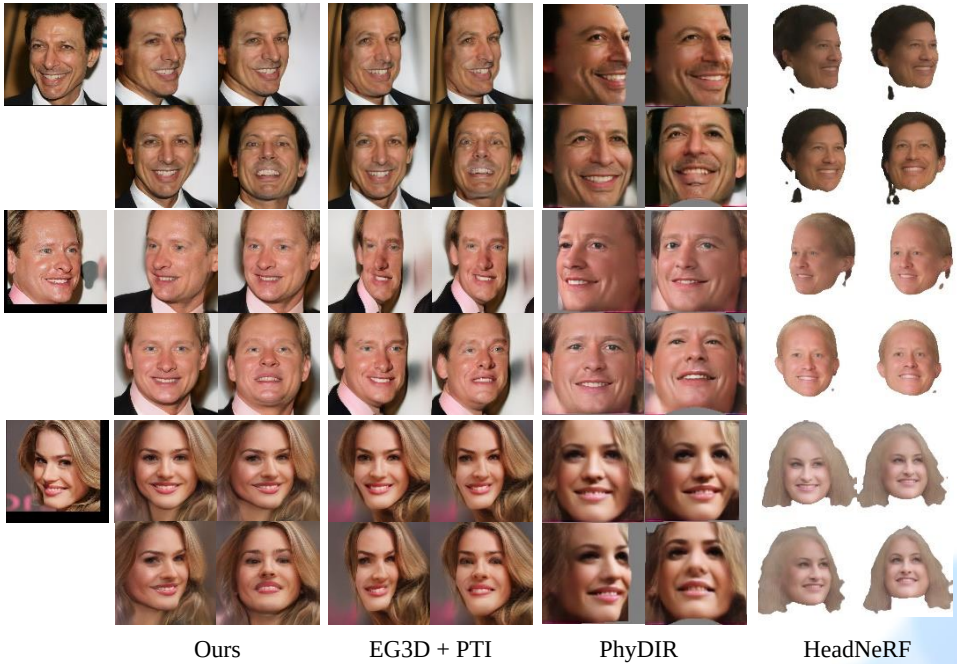
Ablation study: uncertainty modeling & losses

collection Ours w/o uncertainty, avg pooling

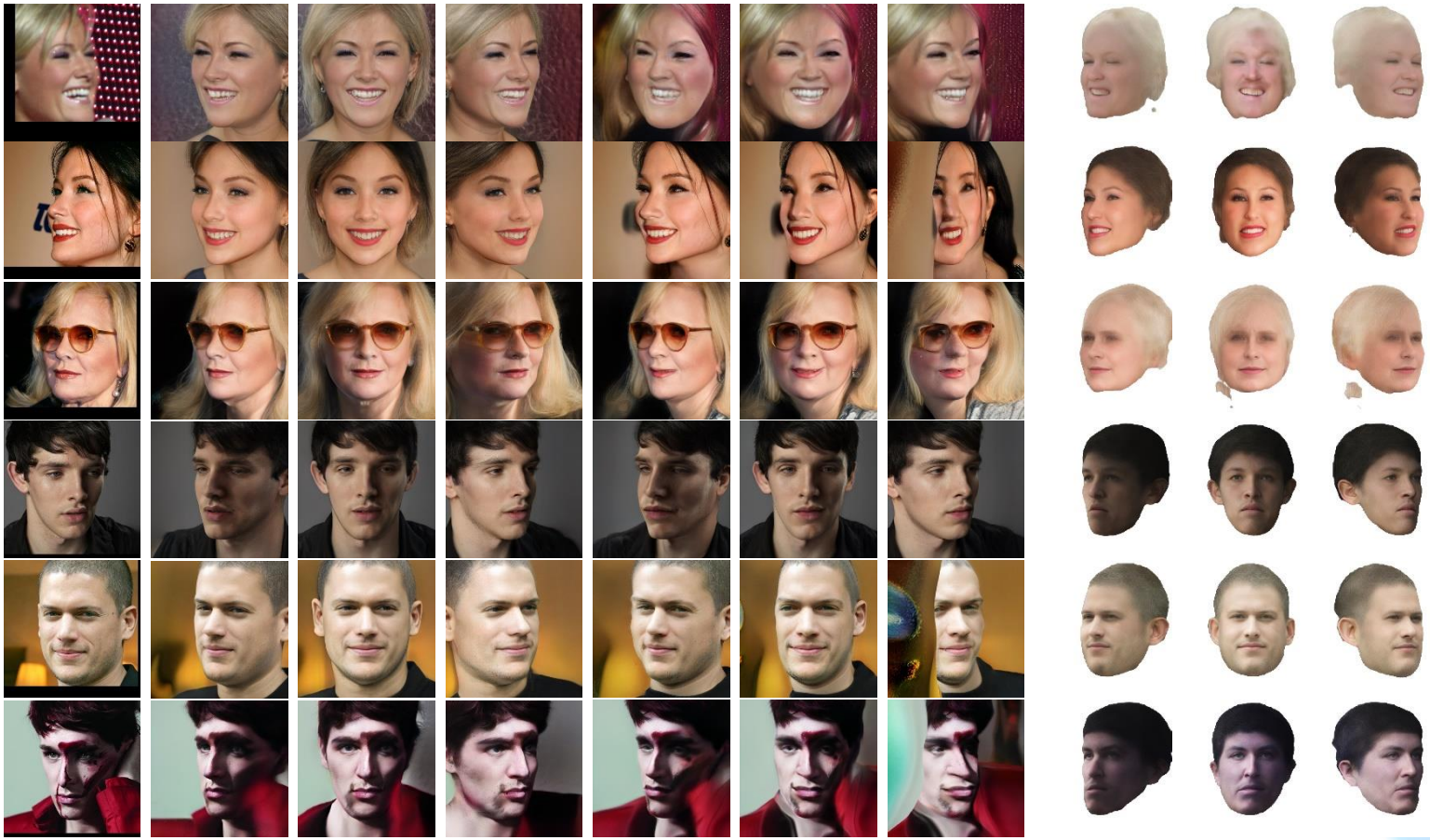
Target Ours w/o L_{ac} Target Ours w/o L_{ac}

- The uncertainty modeling significantly improves the identity preservation
- The appearance consistency loss recovers better texture details

Comparison with state-of-the-art methods



Comparison with state-of-the-art methods



Target Ours EG3D + PTI HeadNeRF

More results on challenging conditions

Thanks for watching our presentation