NeRF-GAN Distillation for Efficient 3D-Aware Generation with Convolutions

Mohamad Shahbazi[1] Evangelos Ntavelis[1, 3] Alessio Tonioni[2] Edo Collins[2] Martin Danelljan[1] Danda Paudel[1] Luc Van Gool[1]

[1]Computer Vision Lab, ETH Zurich, Switzerland [2]Google Zurich [3]ML & Robotics, CSEM, Switzerland

Summary

Goal

- Efficient inference of 3D-aware GANs using fully convolutional pose-conditioned generators

Method

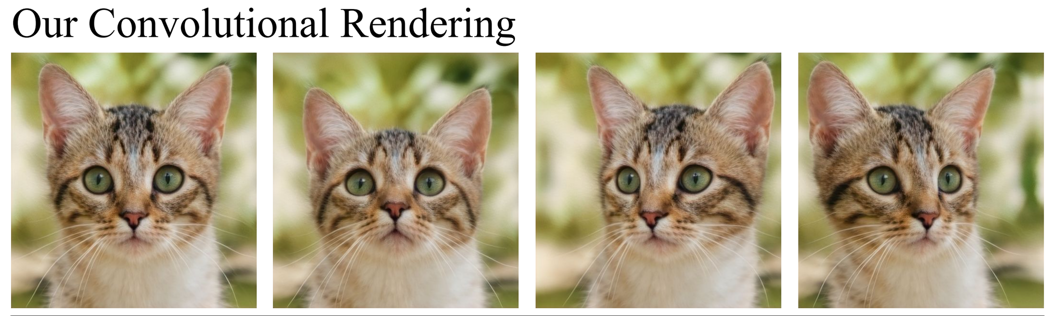
- Distilling a pretrained NeRF-GAN into a pose-conditioned convolutional generator

Conclusion

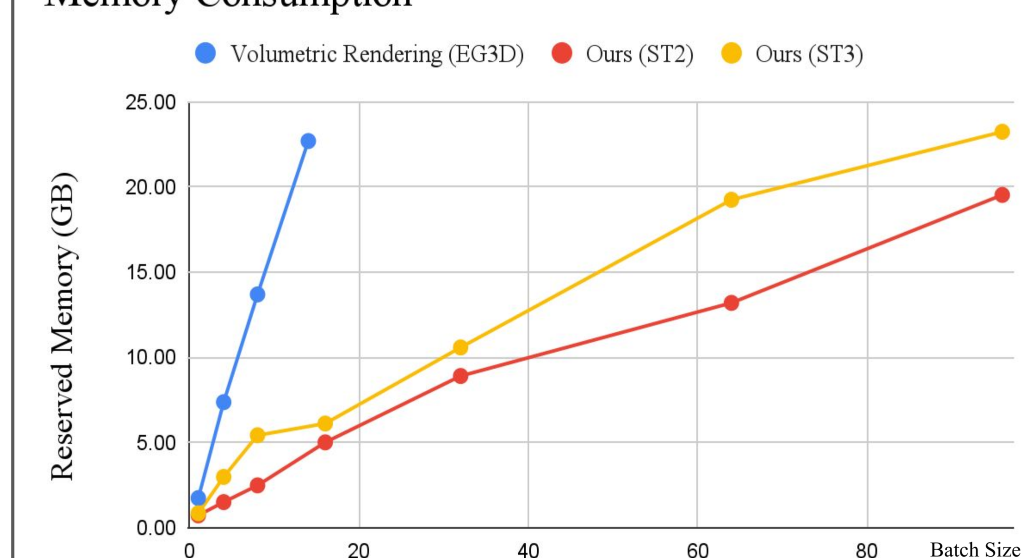
- Comparable 3D consistency and the image quality with the pretrained NeRF-GAN, while benefiting from the computational efficiency of the convolutional architecture.

Volumetric Rendering (EG3D)

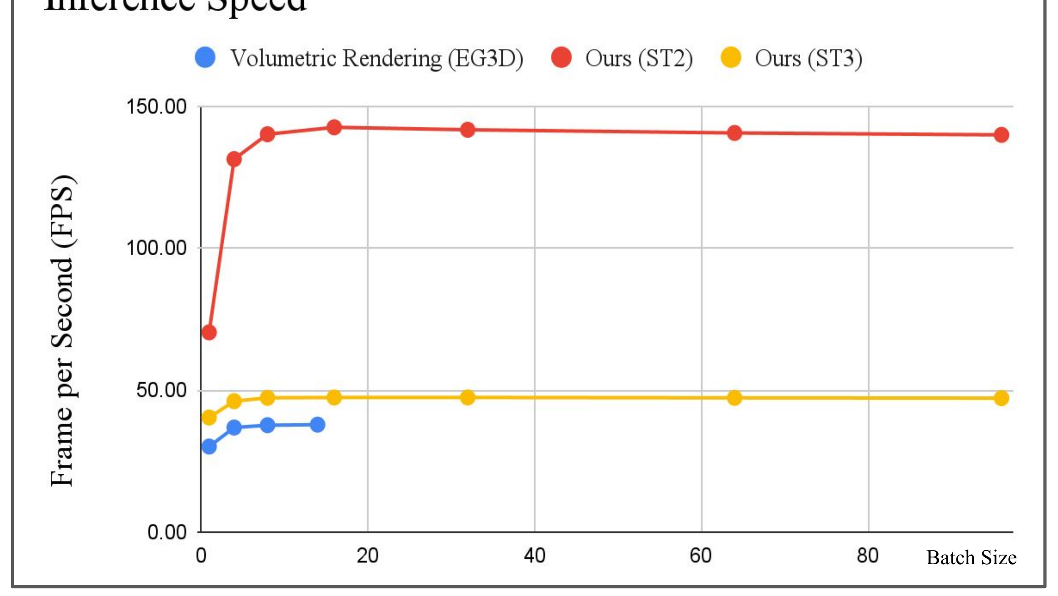
Our Convolutional Rendering



Memory Consumption



Inference Speed



Method

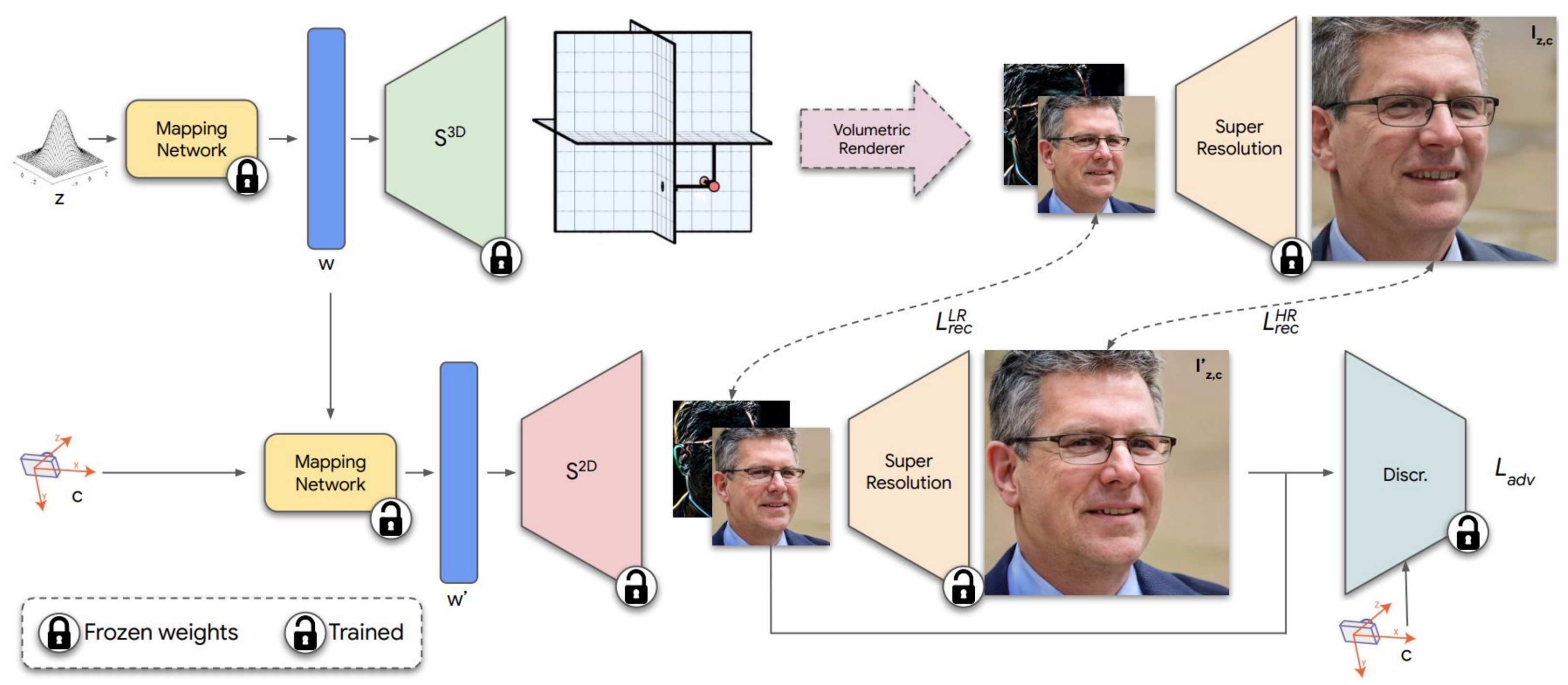
The Proposed Method

Model

- A convolutional generator conditioned on the latent code of the pretrained NeRF-GAN and the target viewpoint

Training

- The pretrained NeRF-GAN as the teacher for supervision
- Reconstruction and adversarial objectives



Two-Stage Training

- **Stage 1**: training only with reconstruction loss
- **Stage 2**: training with reconstruction and adversarial losses

The proposed two-stage training leads to better 3D consistency!

Mitigating Pose-Attribute Correlation

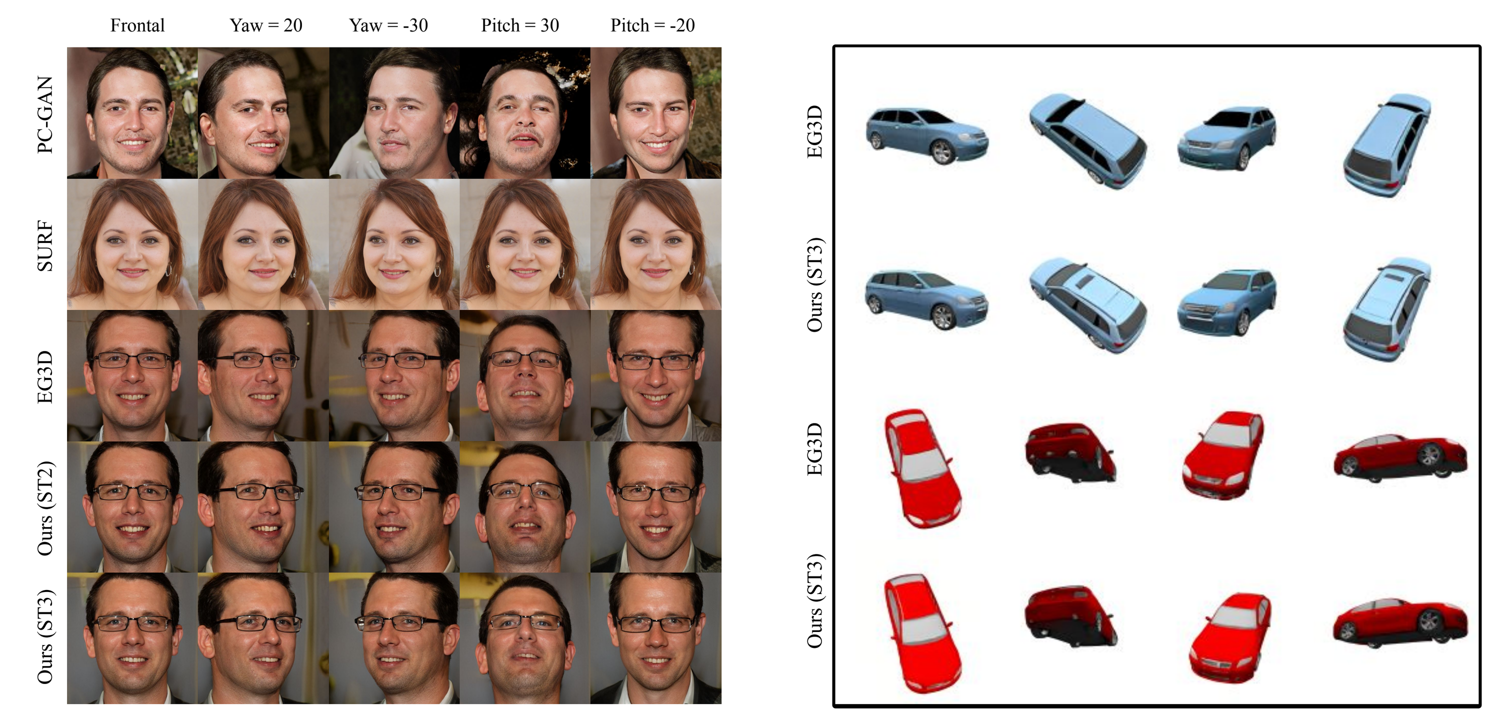
- Convolutional generators are prone to pose-attribute bias in the training data
- Mitigate the bias by mixing real and NeRF-GAN-generated data as real samples for the adversarial training

Github:
https://github.com/mshahbazi72/NeRF-GAN-Distillation

Email:
mshahbazi@vision.ee.ethz.ch

Experiments

Qualitative Results on FFHQ and Shapenet Cars



Quantitative Comparison of Visual Quality

Method	FFHQ		AFHQ		ShapeNET Cars	
	FID ↓	KID ↓	FID ↓	KID ↓	FID ↓	KID ↓
EG3D [5]	5.0	0.0018	2.9	0.0003	3.5	0.0017
PC-GAN	19.3	0.0085	4.5	0.0009	6.1	0.0018
LiftGAN [48]	29.8*	-	-	-	-	-
SURF	31.1	0.0153	-	-	-	-
Ours (ST2)	6.6	0.0019	3.8	0.0011	3.1	0.0013
Ours (ST3)	6.8	0.0023	3.2	0.0007	3.1	0.0012

Quantitative Comparison of 3D Consistency

Method	Pose Acc. ↓	3D Landmark ↓	ID ↑
EG3D [5]	0.002	0.018	0.75
PC-GAN	0.009	0.062	0.56
SURF	0.044	0.014	0.86
Ours (ST2)	0.002	0.023	0.75
Ours (ST3)	0.002	0.022	0.75

Examples of Inversion and Editing using Our Method