PointInverter: Point Cloud Reconstruction and Editing via a Generative Model with Shape Priors

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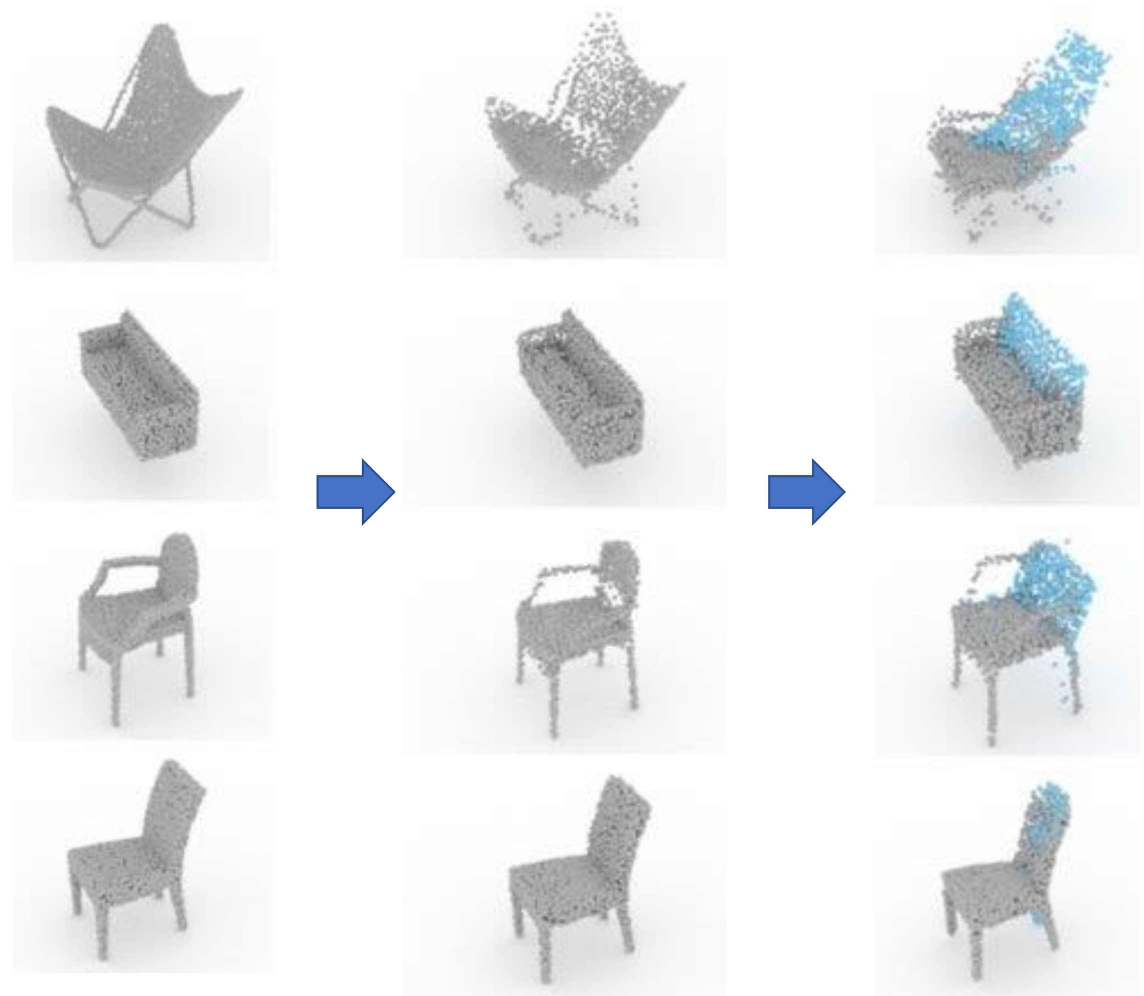
1. Overview

- In the 2D domain, an GAN inversion is a common approach to editing real data with generative models.
- Recent point cloud generative models produce the high-quality objects and semantic parts.
- However, few studies have been conducted on how to use point cloud GANs for inversion.



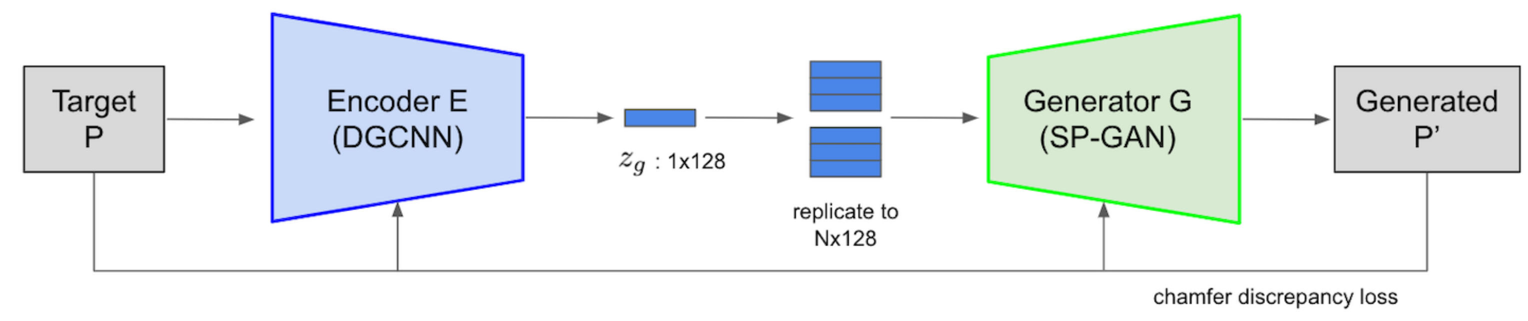
Target Inversion Edition

2. Contribution

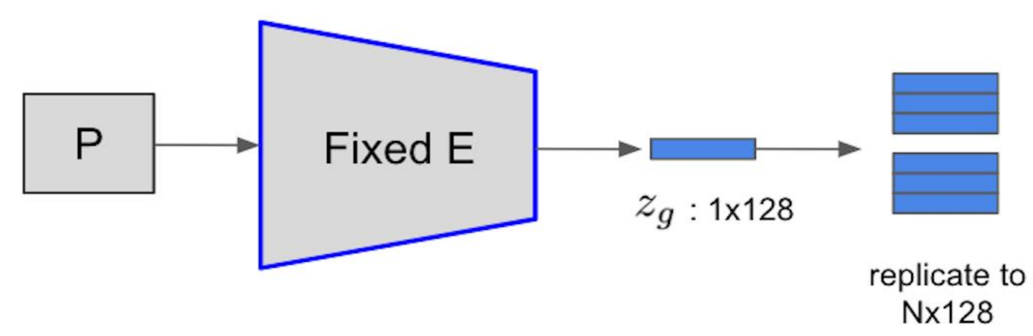
- We introduce a novel **hybrid-based** point cloud GAN inversion network.
- Global and local latent code refinements to resolve the **point ordering** and prevent the **generator overfitted**.
- We show the state art of result results in point cloud GAN inversion.

3. Method

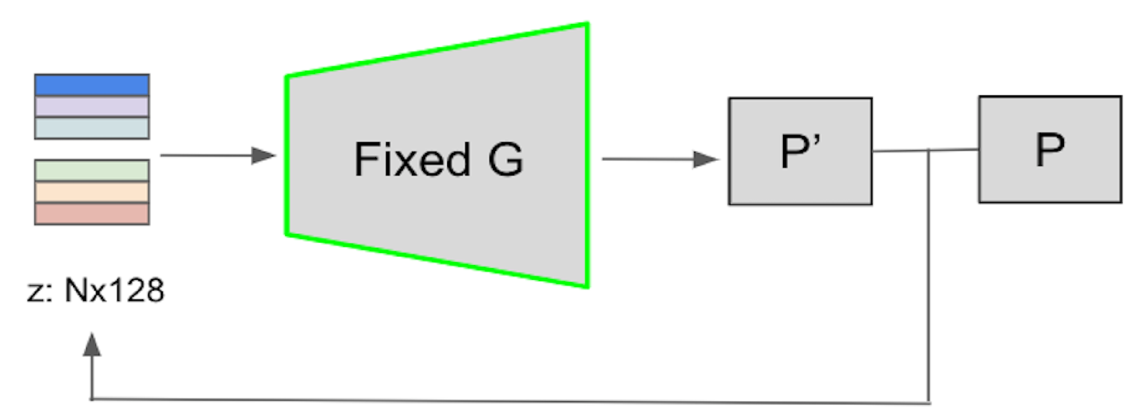
- First, train the encoder to map the **global** latent code with SP-GAN as pretrained GAN.



- Second, initialize latent code extracted by encoder.



- Third, optimize to **local** latent codes corresponding to each point.



- Global and local refinement, it is possible to solve t he point ordering problem and **maintain the dense correspondence**.
- The local latent code optimization maps the local detail easily based on provided global latent code, without overfitting.

4. Comparison on reconstruction

- Qualitative Results

Target Achlioptas et al. Zhang et al. **Ours**

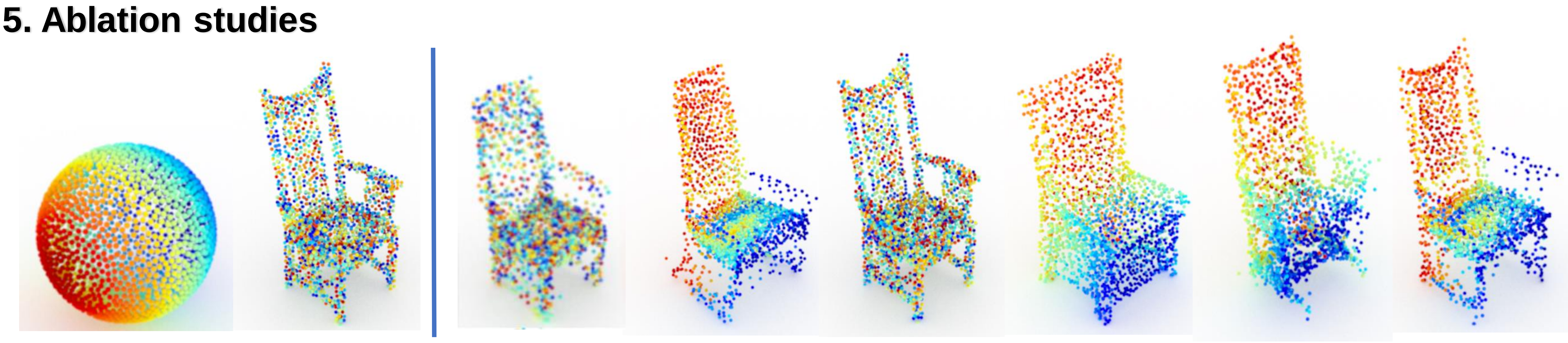
Target Achlioptas et al. Zhang et al. **Ours**

- Quantitative Results

	avg.	chair	airplane	car	lamp
Achlioptas et al.	3.46×10^{-3}	3.61×10^{-3}	1.15×10^{-3}	1.14×10^{-3}	7.95×10^{-3}
Zhang et al.	2.50×10^{-3}	2.09×10^{-3}	3.59×10^{-3}	1.95×10^{-3}	2.38×10^{-3}
Ours	$\mathbf{0.54 \times 10^{-3}}$	$\mathbf{0.66 \times 10^{-3}}$	$\mathbf{0.49 \times 10^{-3}}$	$\mathbf{0.55 \times 10^{-3}}$	$\mathbf{0.49 \times 10^{-3}}$

	avg.	chair	airplane	car	lamp	animal
Learning-based, global	2.23×10^{-3}	2.11×10^{-3}	0.94×10^{-3}	1.87×10^{-3}	4.03×10^{-3}	2.23×10^{-3}
Learning-based, local	0.62×10^{-3}	0.59×10^{-3}	0.35×10^{-3}	0.62×10^{-3}	0.31×10^{-3}	1.27×10^{-3}
Optimization-based, global	45.5×10^{-3}	13.5×10^{-3}	73.1×10^{-3}	94.9×10^{-3}	17.6×10^{-3}	28.4×10^{-3}
Optimization-based, local	21.2×10^{-3}	2.60×10^{-3}	23.4×10^{-3}	48.6×10^{-3}	2.77×10^{-3}	7.48×10^{-3}
Ours	0.63×10^{-3}	0.66×10^{-3}	0.49×10^{-3}	$\mathbf{0.55 \times 10^{-3}}$	0.49×10^{-3}	$\mathbf{0.98 \times 10^{-3}}$

5. Ablation studies



SP-GAN (Sphere) | Target | TreeGAN (Global) | SP-GAN (Encoder, Global) | SP-GAN (Encoder, Local) | SP-GAN (Optimization, Global) | SP-GAN (Optimization, Local) | **Ours**