ComPC: Completing a 3D Point Cloud with 2D Diffusion Priors

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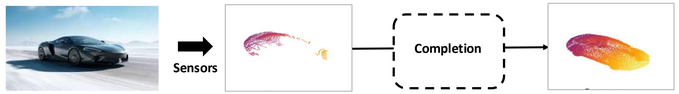
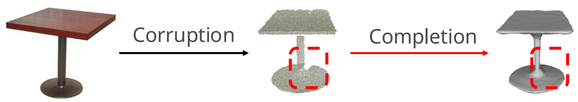
Introduction

➢ Problem Definition

Due to the self-occlusion of 3D objects, direct scanned point clouds from sensors in specific viewpoints are usually incomplete. Point cloud completion aims to recover completed 3D shape from such partial observation, which may be helpful for subsequent perception or reconstruction.



(1) 3D assets Repairing?

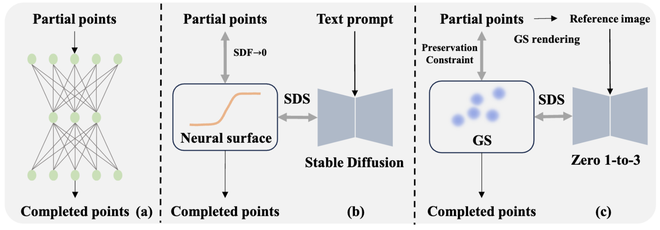


(2) Completion for Robots?

How to handle this? Don't know Guess we can handle this

➢ Can we Complete 3D Point Clouds with 2D Diffusion?

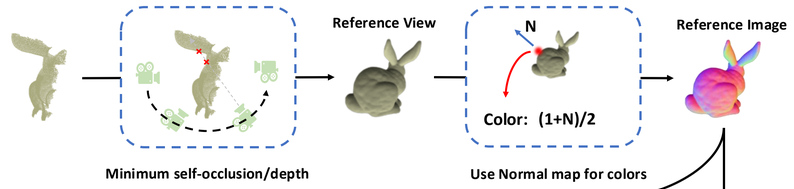
- Methods (a) completes partial point clouds directly through networks trained on specific 3D completion datasets;
- Methods (b) introduces text-driven 2D diffusion priors to optimize the Neural surface represented by VolSDF;



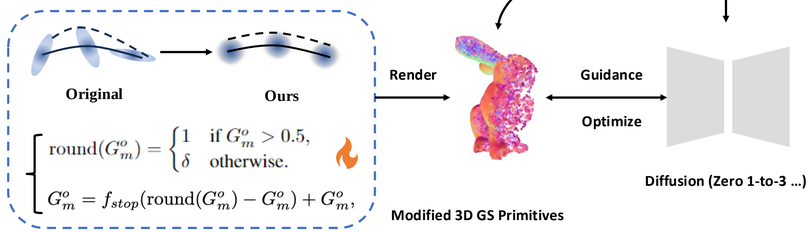
- Our method (c) does not rely on the manually defined text prompts. It estimate a reference image to condition the image-conditioned model, e.g., Zero-1-to-3, to optimize Gaussian Primitives for completion.

Methodology

- **Reference Viewpoint Estimation.**

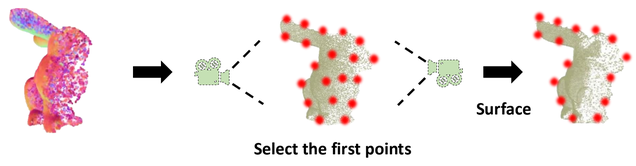


- **Calculate the guidance to optimize 3DGS.**

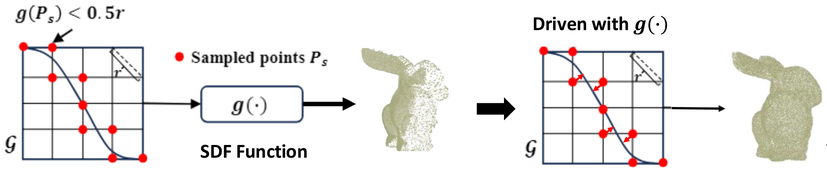


1. Reference Viewpoint Estimation: (1) Find the viewpoint with most complete observation; (2) Colorize the reference view through the normal map;
2. Zero-shot Fractal Completion: (1) Modify the vanilla Gaussian to fit point clouds extraction; (2) Using partial points to initialize frozen Gaussian, and combine it with optimizable Gaussian primitives to render 2D image for the acquirement of guidance from 2D diffusion models;

- **Surface Extraction Module.**

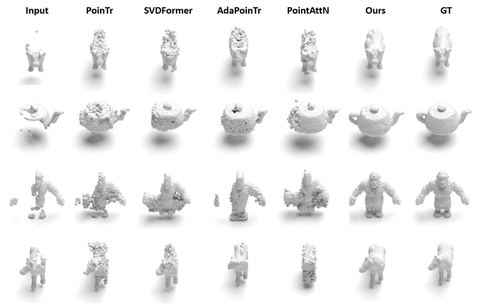


- **Grid Pulling operation.**

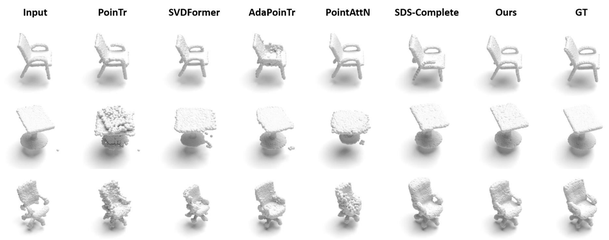


3. Surface Extraction Module: Since the Gaussian primitives may distribute both on and below the surface, we extract surface points from the first Gaussian in each pixel;
4. Grid Pulling Operation: (1) Fit a SDF function $g(\cdot)$ represented by MLP to the non-uniform surface points; (2) Resample uniform points from a regular 3D grid with $g(\cdot)$.

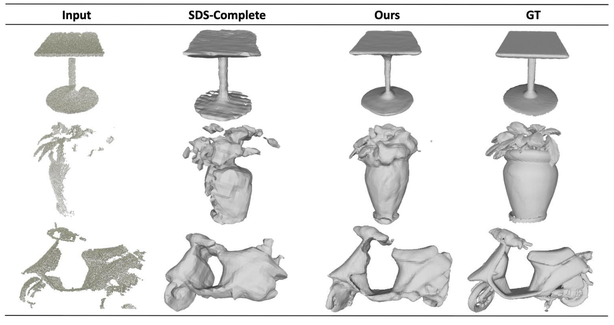
Experimental Results



Comparisons on the completion of synthetic data.



Comparisons on the completion of real scans.



Comparisons based on the Mesh Completion.

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