

RealDiff: Real-world 3D Shape Completion using Self-Supervised Diffusion Models

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Project page



Let's connect!

What is RealDiff?

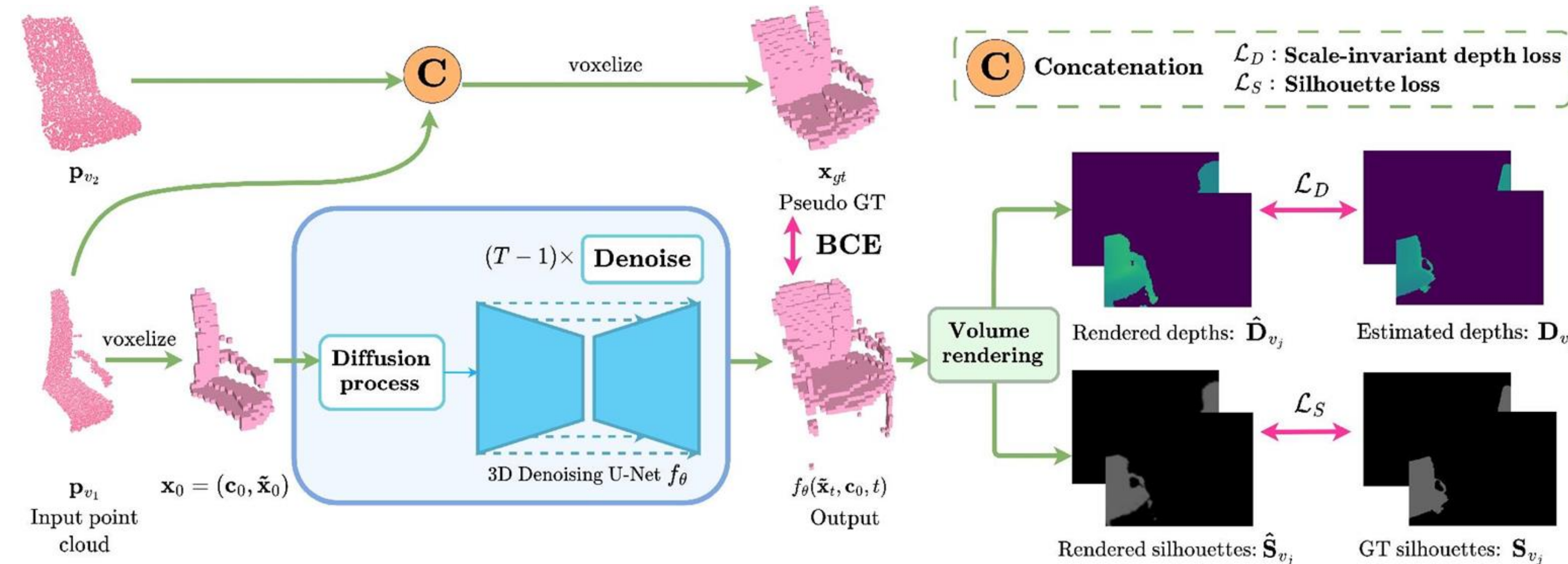
Motivation

- Real-world point clouds are sparse, noisy, and incomplete, limiting downstream 3D perception.
- Paired real-world supervision is scarce, while synthetic CAD priors do not transfer reliably.

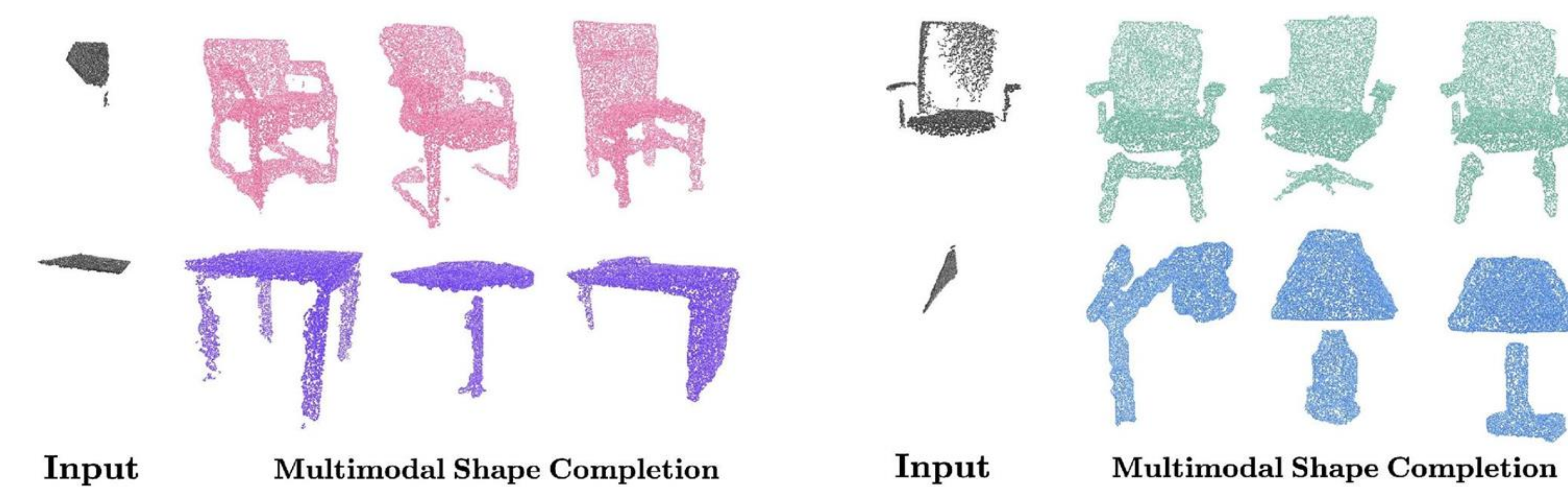
Contribution

Learn completion directly from real scans — no synthetic shape priors.

Self-supervised conditional diffusion over missing voxels + silhouette and depth supervision.

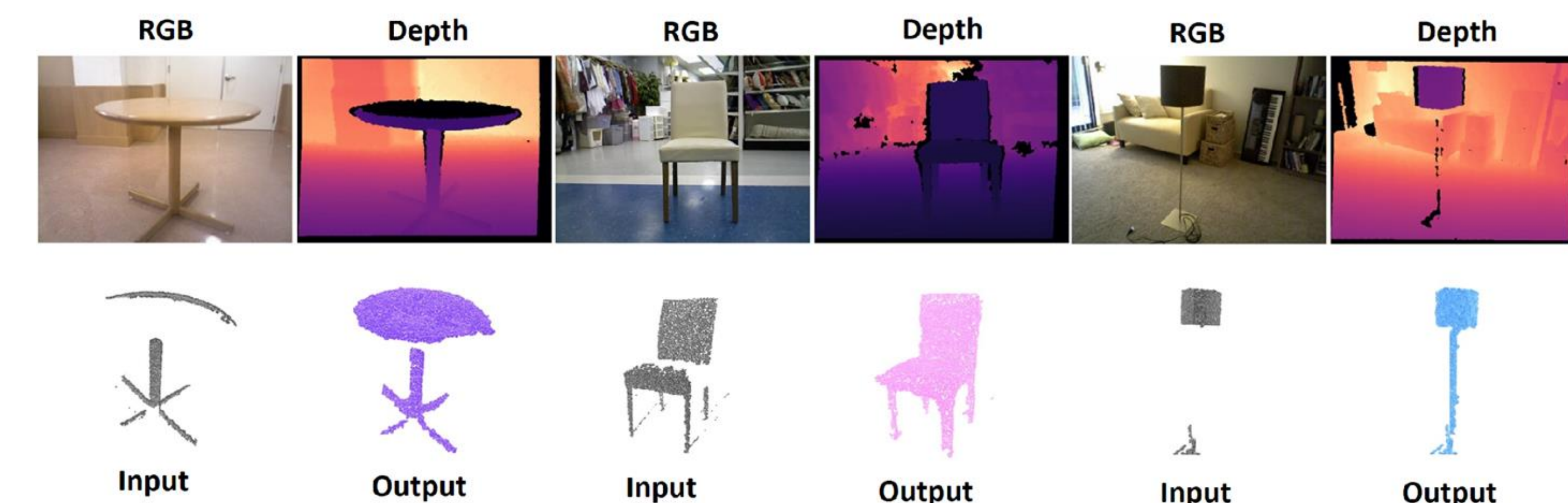


Multiple plausible completions



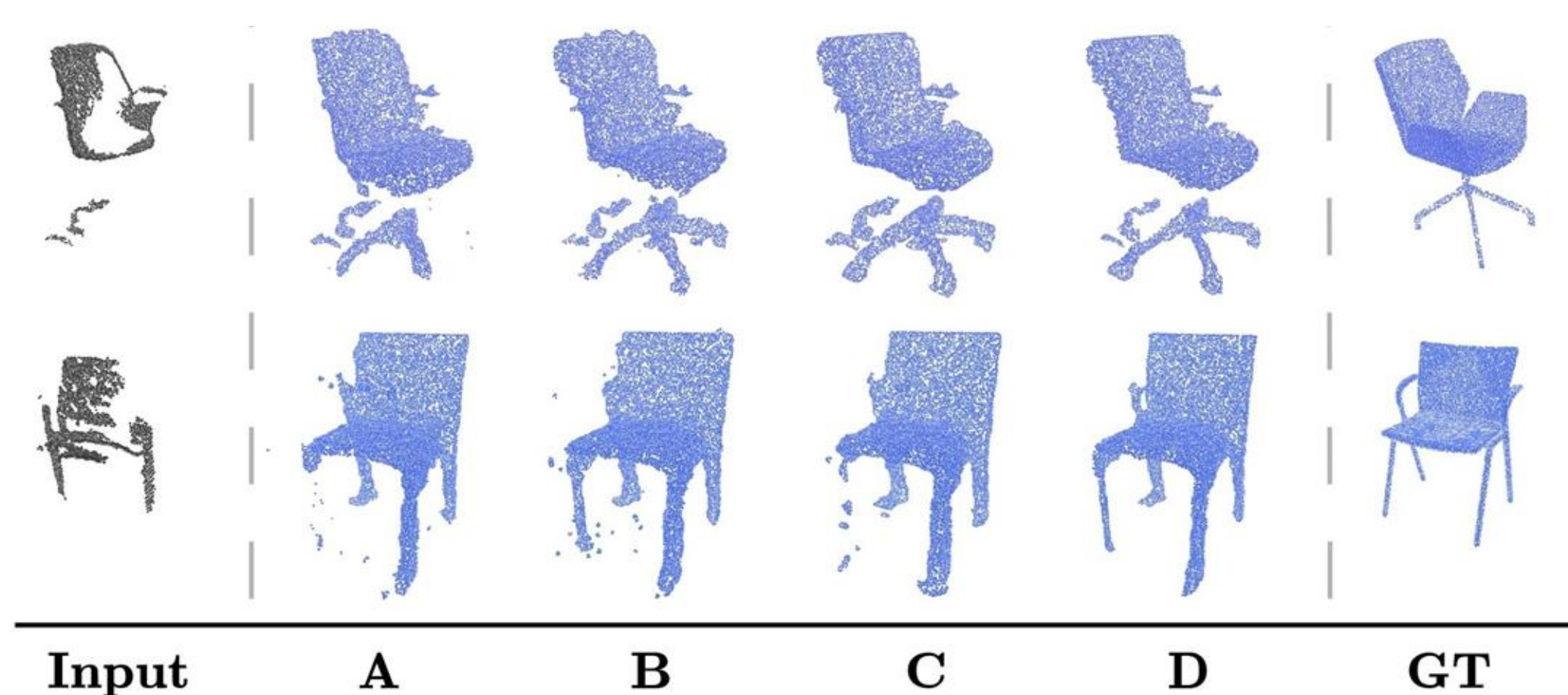
Best MMD and UHD across all categories
completion quality · fidelity
One input, many plausible completions. More incomplete inputs yield more diversity.

Generalizes across real-world datasets



ScanNet → Redwood 3DScans
Trained on ScanNet, directly applied to another real-world dataset.

Why geometric priors matter



Silhouette → completeness
Depth → smoothness
Both → best

A none · B silhouette
C depth · D both

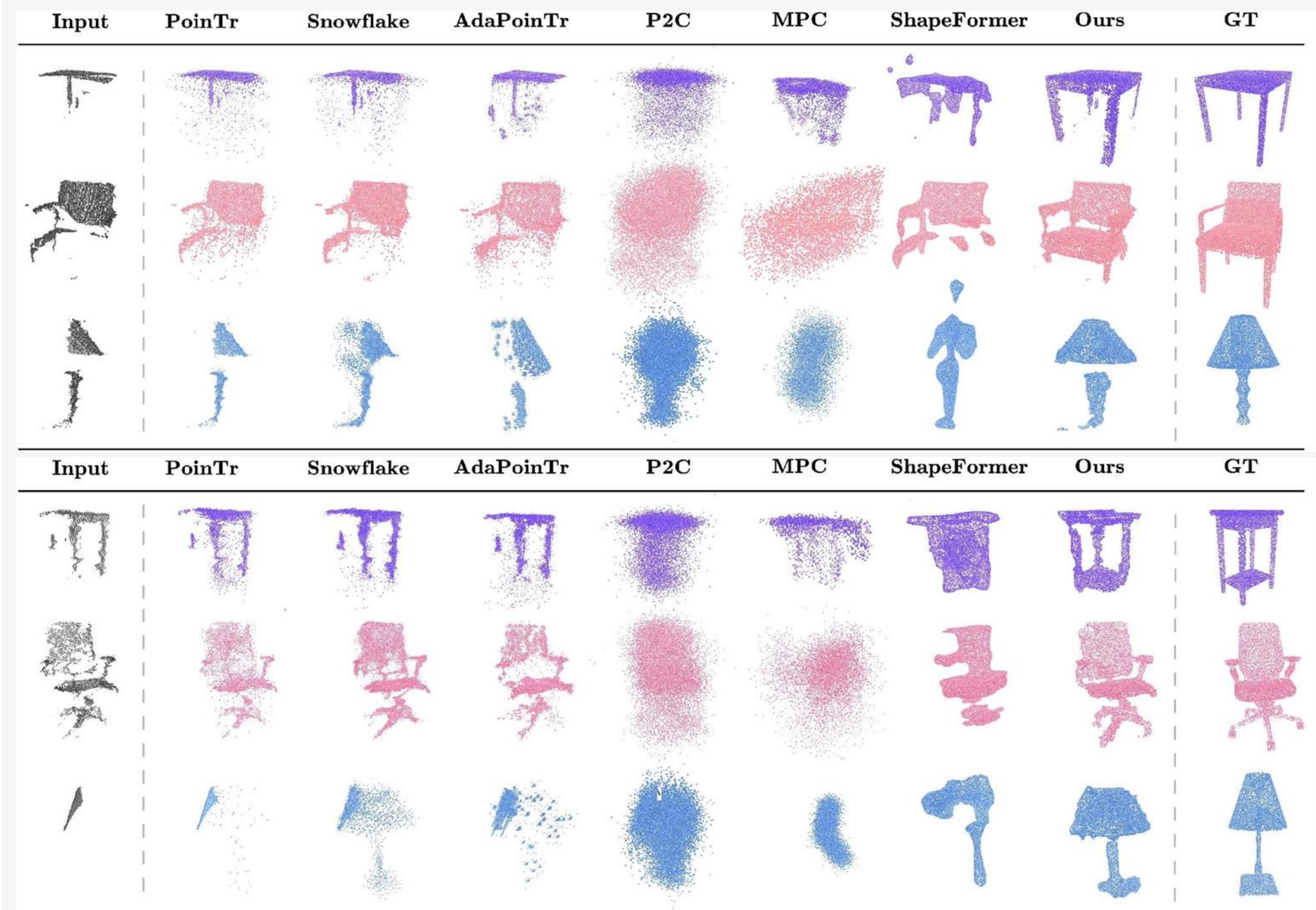
Results

Completion on real-world ScanNet scans

Method	Chair				Lamp				Table			
	rec.↑	prec.↑	F1↑	EMD↓	rec.↑	prec.↑	F1↑	EMD↓	rec.↑	prec.↑	F1↑	EMD↓
PoinTr	0.12	0.23	0.14	67.61	0.11	0.28	0.16	57.62	0.16	0.43	0.22	83.38
SnowflakeNet	0.14	0.24	0.17	64.74	0.19	0.37	0.24	61.33	0.18	0.42	0.23	84.34
AdaPoinTr	0.13	0.27	0.16	66.01	0.18	0.44	0.24	65.27	0.18	0.47	0.25	74.92
P2C	0.31	0.13	0.18	78.77	0.48	0.15	0.22	56.28	0.24	0.15	0.17	105.14
MPC	0.10	0.09	0.09	90.72	0.10	0.08	0.09	91.85	0.16	0.17	0.16	98.04
ShapeFormer	0.17	0.21	0.18	64.66	0.11	0.11	0.10	79.45	0.12	0.11	0.11	152.19
Ours	0.23	0.21	0.21	61.29	0.25	0.30	0.26	47.58	0.25	0.30	0.26	66.15

16,384 points. F1: accuracy + completeness · EMD: uniformity. **Best F1 and EMD across all categories.**

Qualitative results



Baselines stay near observed regions or produce blobs; **RealDiff** recovers complete shapes with fine details and smooth surfaces.