Learning to Infer Implicit Surfaces without 3D Supervision

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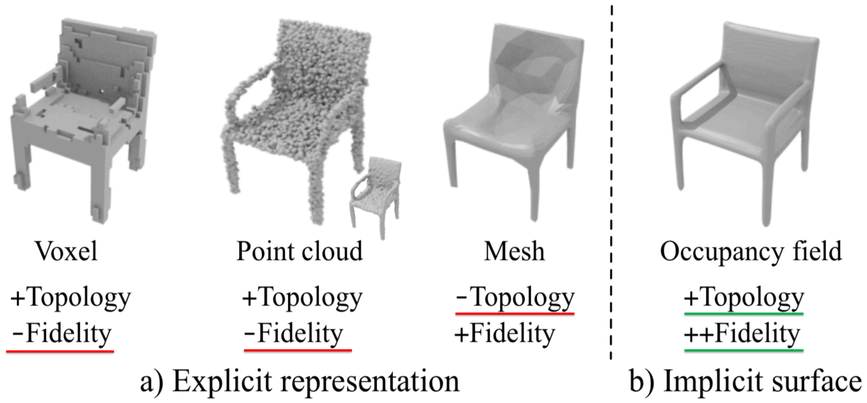
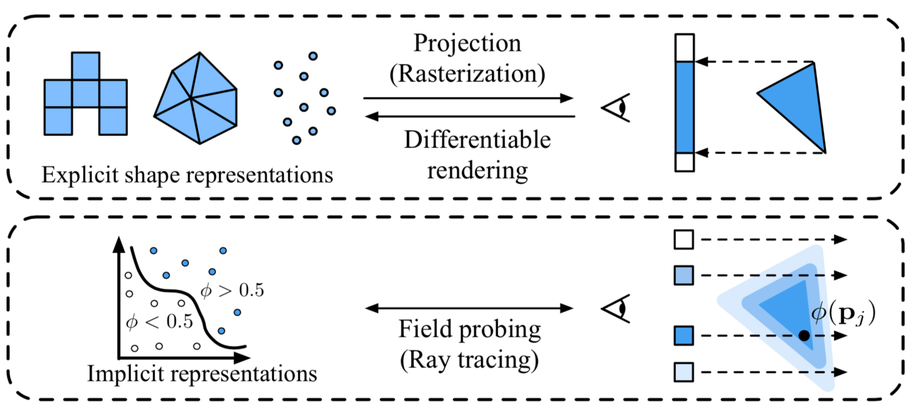
Motivation / Challenges

Q: "Can we learn high-resolution geometry with an arbitrary topology without 3D supervision?"

Need Effective 3D Data Representation

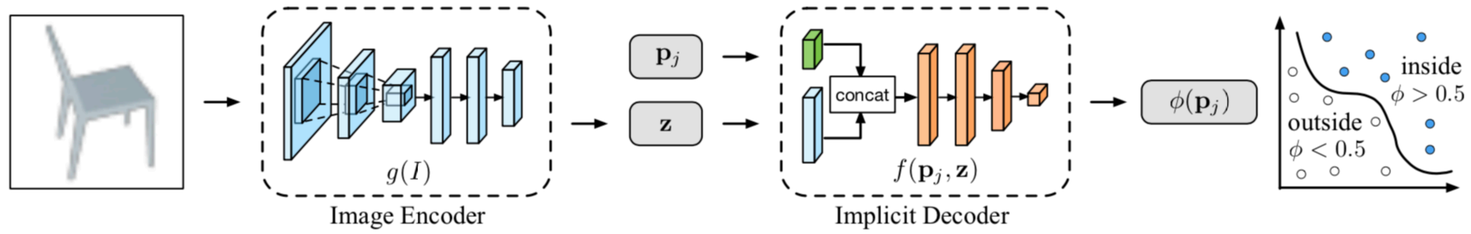


How to Differentiablly Render Implicit Function Efficiently?

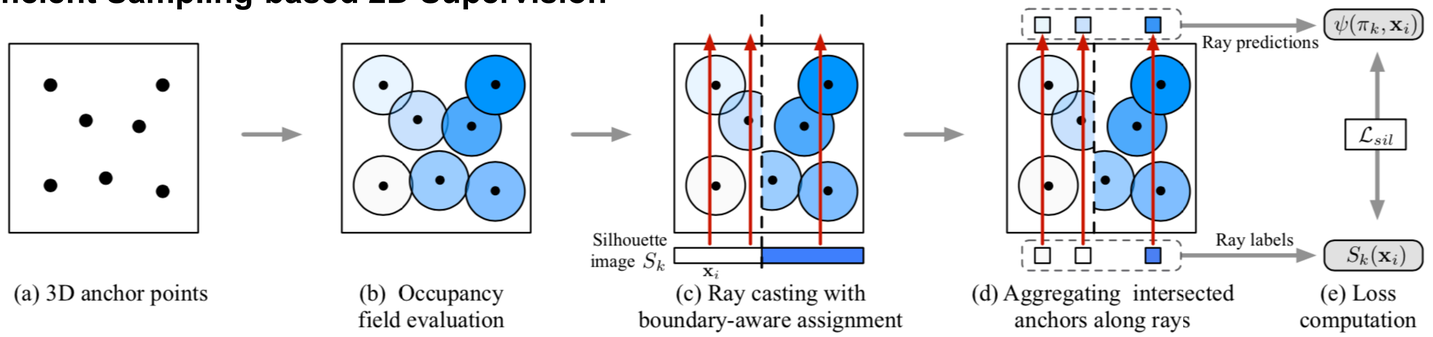


Method

Our Framework: Single-view 3D Object Reconstruction using Implicit Surface

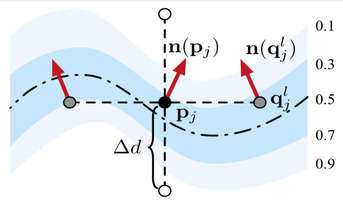


Efficient Sampling-based 2D Supervision



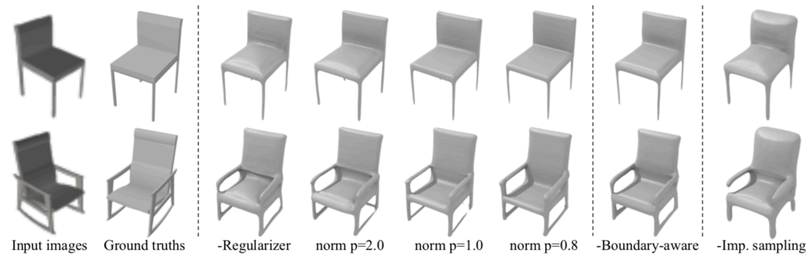
Geometric Regularization on Implicit Surface

$$\mathcal{L}_{geo} = \frac{1}{N_p}\sum_{j=1}^{N_p} W(\phi(\mathbf{p}_j)) \frac{\sum_{l=1}^{6} W(\phi(\mathbf{q}_j^l))\|\mathbf{n}(\mathbf{p}_j) - \mathbf{n}(\mathbf{q}_j^l)\|_p^p}{\sum_{l=1}^{6} W(\phi(\mathbf{q}_j^l))}$$



Ablation Study

Reconstruction accuracy (3D IoU)			
-Reg	0.503	p = 2.0	0.502
-BA	0.531	p = 1.0	0.524
-IS	0.483	p = 0.8	0.554



Results (ShapeNet)

Category	Airplane	Bench	Table	Car	Chair	Mean
PTN [4]	0.5564	0.4875	0.4938	0.7123	0.4494	0.5399
NMR [1]	0.6172	0.4998	0.4829	0.7095	0.4990	0.5617
SoftRas [2]	0.6419	0.5080	0.4487	0.7697	0.5270	0.5789
Ours	**0.6530**	**0.5360**	**0.5250**	**0.7820**	**0.5540**	**0.6100**