

ObjectCarver: Semi-automatic Segmentation, **Reconstruction and Separation of 3D Objects**

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Introduction



Goal: Given multiview posed images of a scene with many objects in contact and under occlusion, segment each object and reconstruct it in 3D from a single user click.

Limitations of prior works:

- They require full segmentation masks
- They produce floating artifacts

Dataset



No dataset exists to evaluate such methods, so we introduce a dataset with 22 scanned 3D objects, 30 real-world scenes, and 5 synthetic scenes.

Method

How can we generate consistent masks across all views?

Key idea: Ground the mask in 3D and project points to 2D to obtain the mask with SAM [3]

How can we reduce floating artifacts?

Key Idea : A compactness loss based on amodal bounding boxes for ambiguities under occlusion

$$L = L_{color} + \lambda L_{eik} + \beta L_{compactness} + \gamma L_{overlap}$$
prevents floating artifacts prevents objects from overlapping
$$L_{compactness} = \sum_{K} \sum_{j \notin Mask_{k}^{occ}} BCE(Mask_{k}(j), opacity(j))$$

$$k^{*} = \arg\min_{k} (SDF_{k}(p))$$

$$L_{overlap}(p) = \sum_{k \neq k^{*}} \max(SDF_{k}(p), 0)$$

$$projected 3D points$$

$$Mask_{k}^{occ}$$

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Consider the blue cylinder:

The cylinder should clearly not extend to A, and include B C is within the amodal bounding box but lies on an occluder (intersection of the two = $Mask_k^{occ}$). The cylinder may or may not extend to C. Thus, no compactness loss. D: is outside the amodal bounding box. The cylinder shouldn't extend to D so add compactness loss

Results



Synthetic

Real

[1] Wu, Qianyi, et al. "Objectsdf++: Improved object-compositional neural implicit surfaces." Proceedings of the IEEE/CVF International Conference on Computer Vision. 2023.

[2] Li, Zizhang, et al. "Rico: Regularizing the unobservable for indoor compositional reconstruction." Proceedings of the IEEE/CVF International Conference on Computer Vision. 2023.

[3] Kirillov, Alexander, et al. "Segment anything." Proceedings of the IEEE/CVF International Conference on Computer Vision. 2023.

Metrics	RICO	ObjectSDF++	Ours
Chamfer ↓	0.124	0.010	0.005
Prec. Ratio \uparrow	0.581	0.972	0.990
Comp. Ratio ↑	0.938	0.994	0.985
Chamfer ↓	0.106	0.094	0.012
Prec. Ratio \uparrow	0.768	0.768	0.945
Comp. Ratio ↑	0.784	0.836	0.945

