



JUNE 18-22, 2023

CVPR

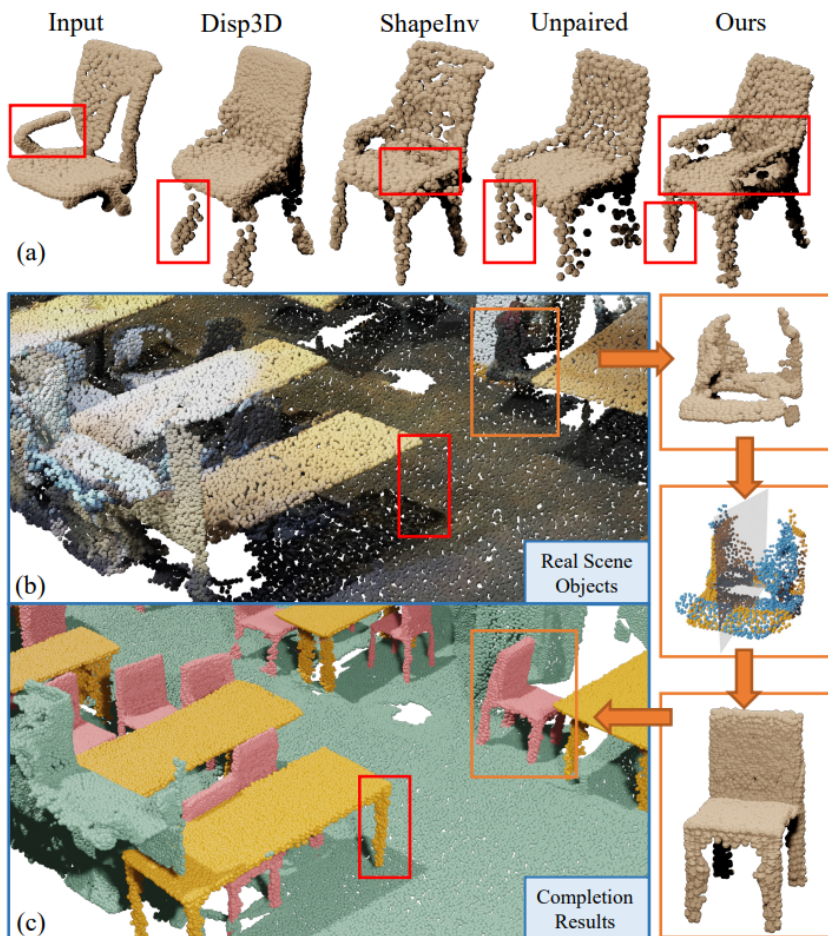
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Symmetric Shape-Preserving Autoencoder for Unsupervised Real ScenePoint Cloud Completion

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Problem

- Data Gap
- Ground Truth
- Details of Existing structure

Solution: USSPA

- Unsupervised Method for Real Scene Data
- Symmetric Shape-Preserving
- Multi-category with Simultaneous Classification
- New Evaluation Method



Artificial



A point cloud from ShapeNet
artificial data

Background

Artificial



A point cloud from ShapeNet artificial data

Real Scene



A partial point cloud from ScanNet real scene data

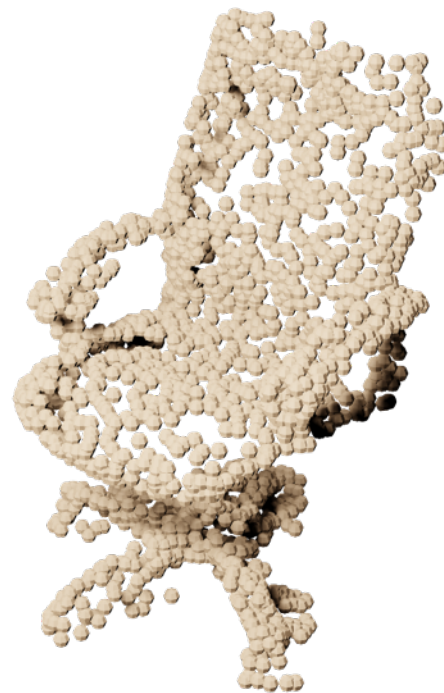
Artificial



A partial point cloud from ShapeNet artificial data



A point cloud from ShapeNet artificial data



A partial point cloud from ScanNet real scene data

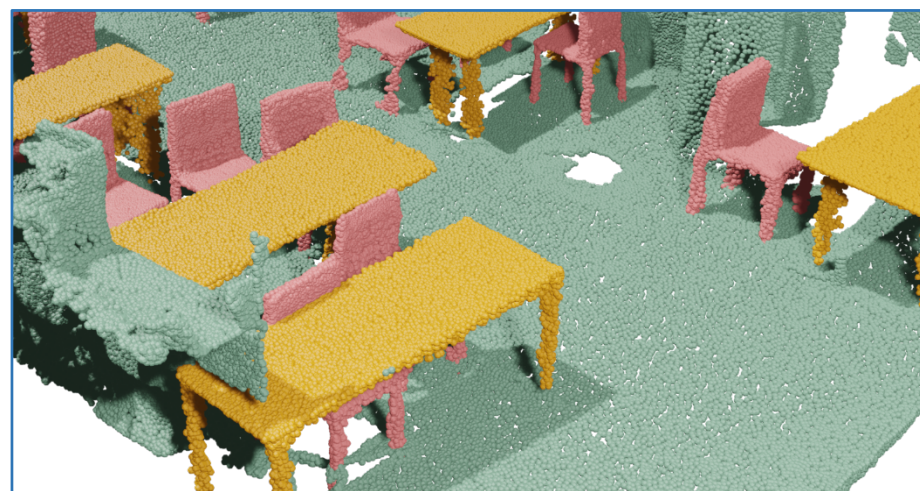
Real Scene



The ground truth is unavailable

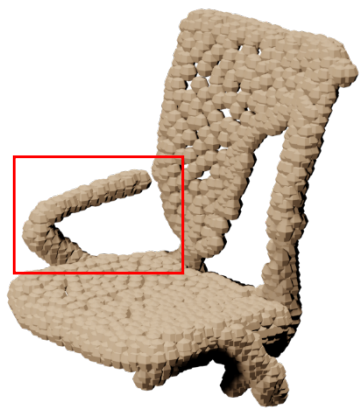


Real Scene Objects

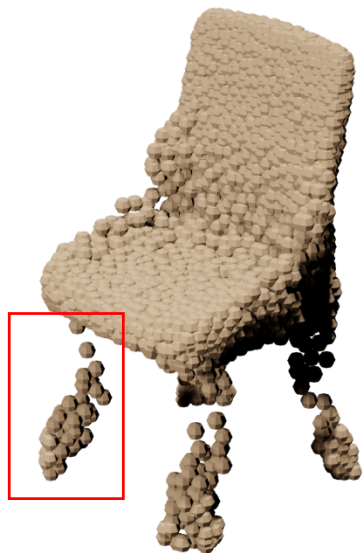


Completion Results

Related Work



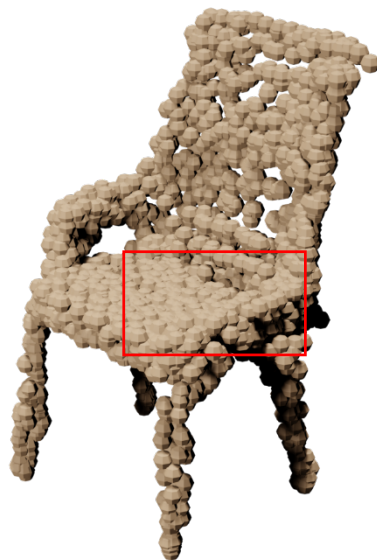
Input



Disp3D

[Wang et.al. CVPR2022]

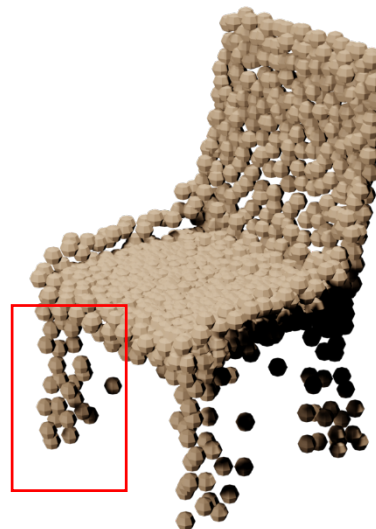
Supervised Method



ShapeInv

[Zhang et.al. CVPR2021]

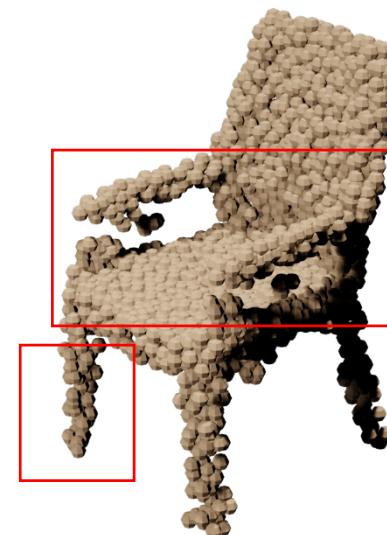
Unsupervised Method
(Optimization)



Unpaired

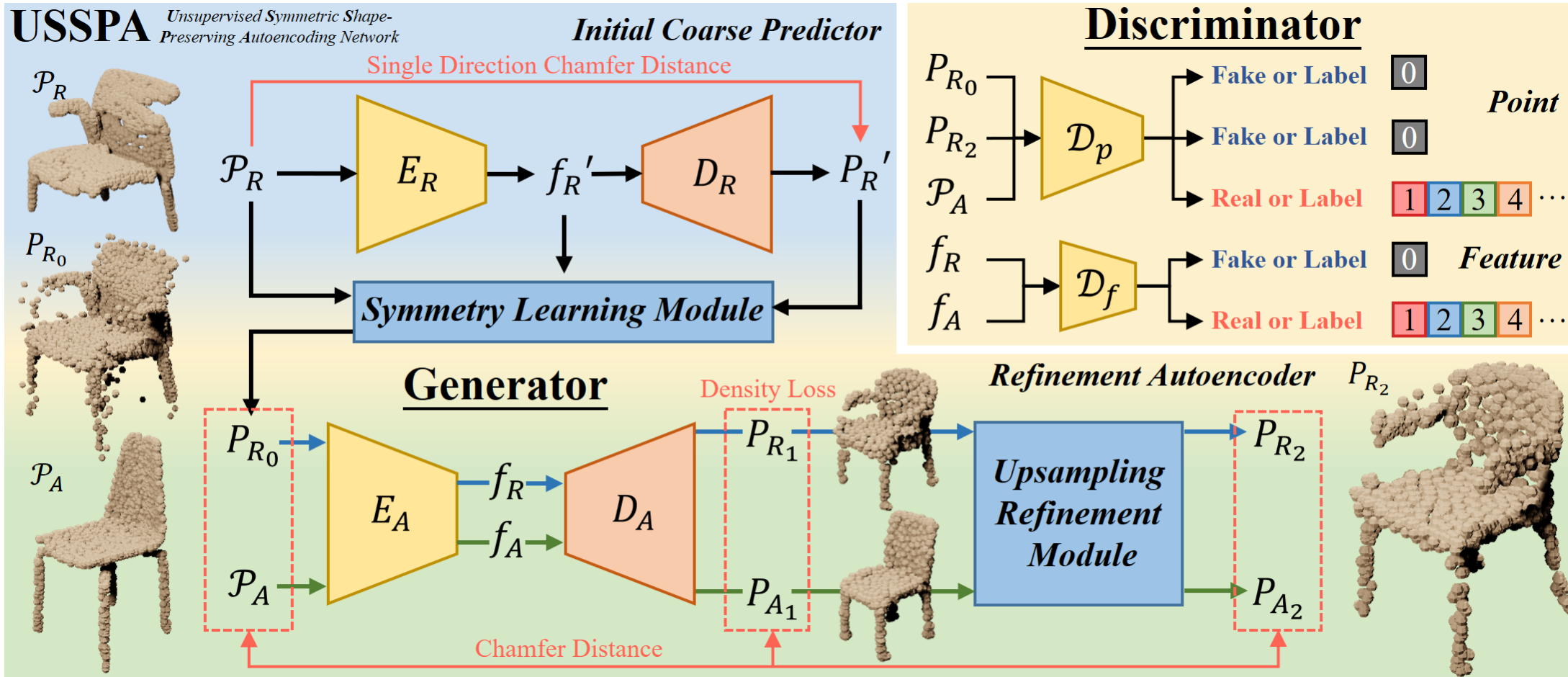
[Mitra et.al. ICLR 2020]

Unsupervised Method

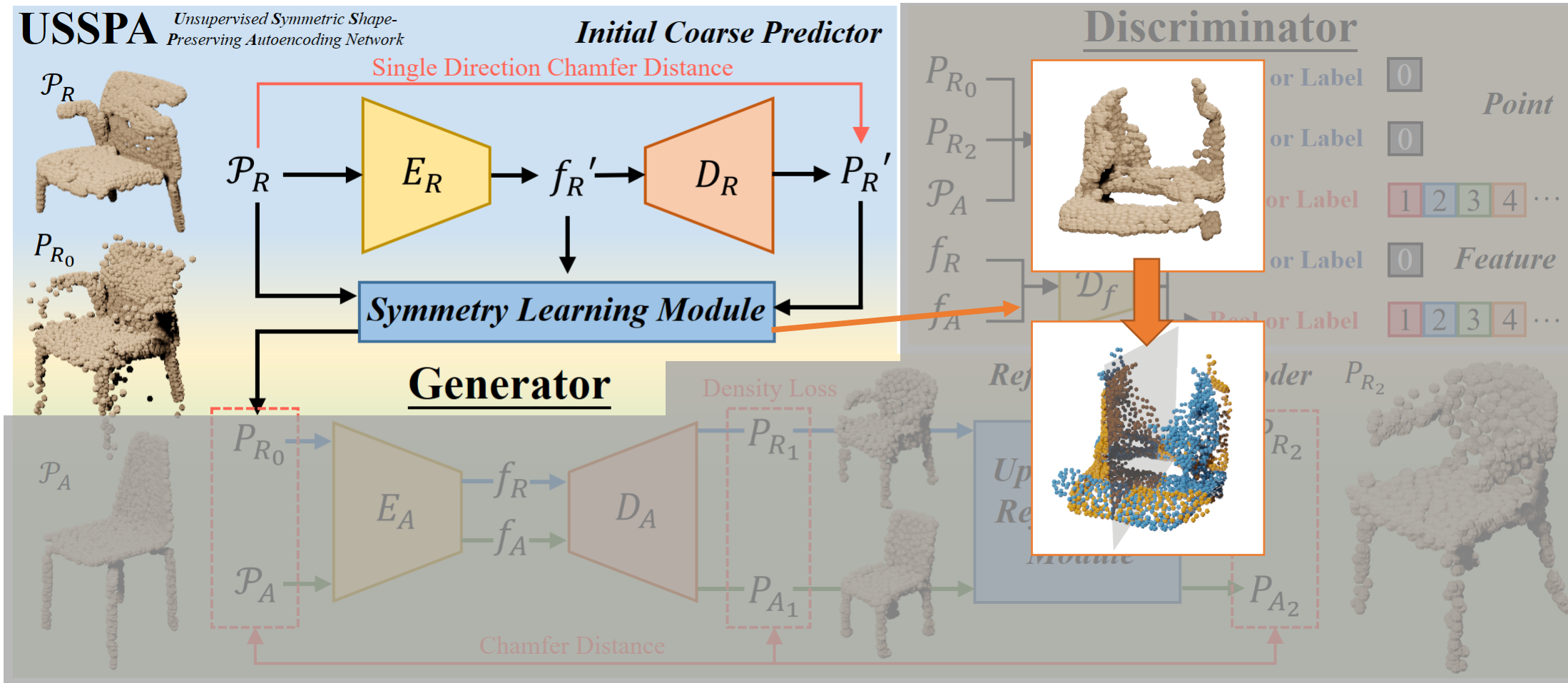


Ours

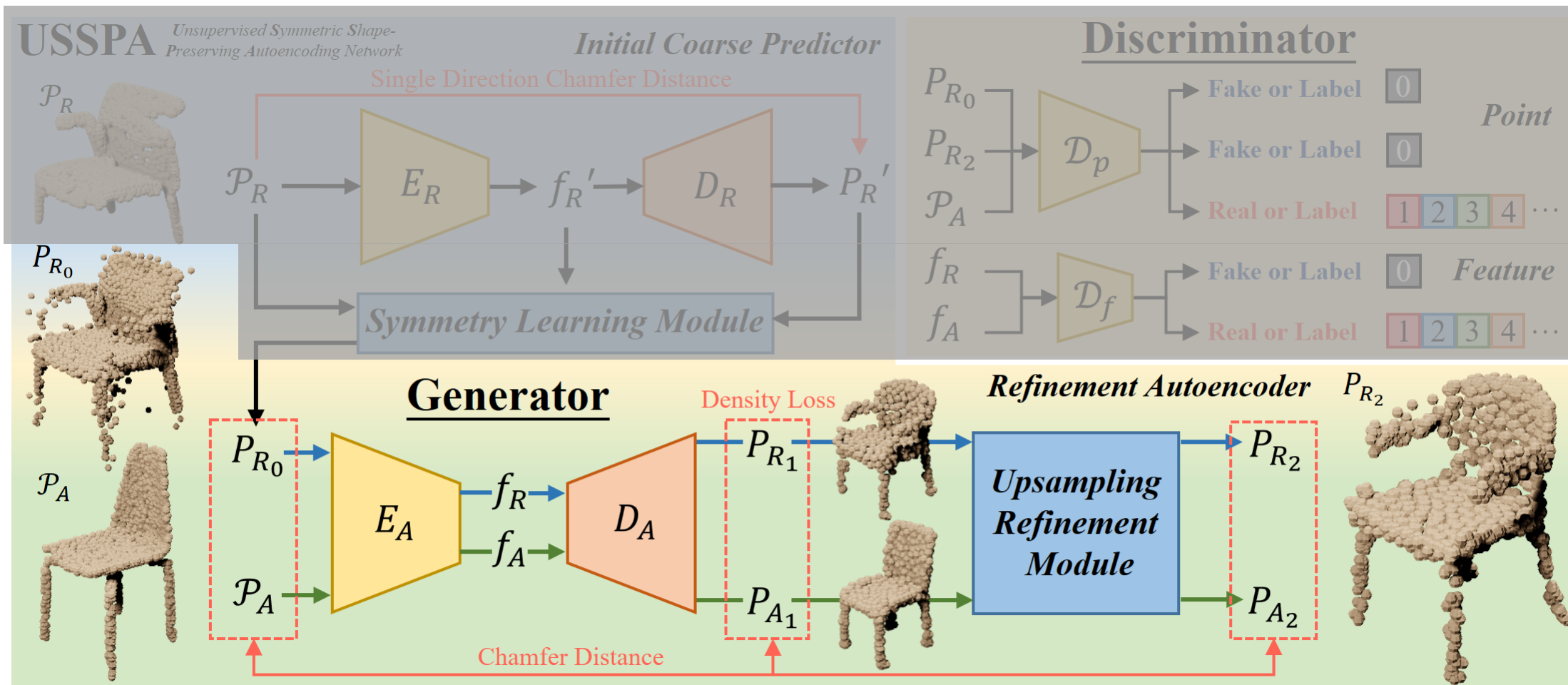
Our Method



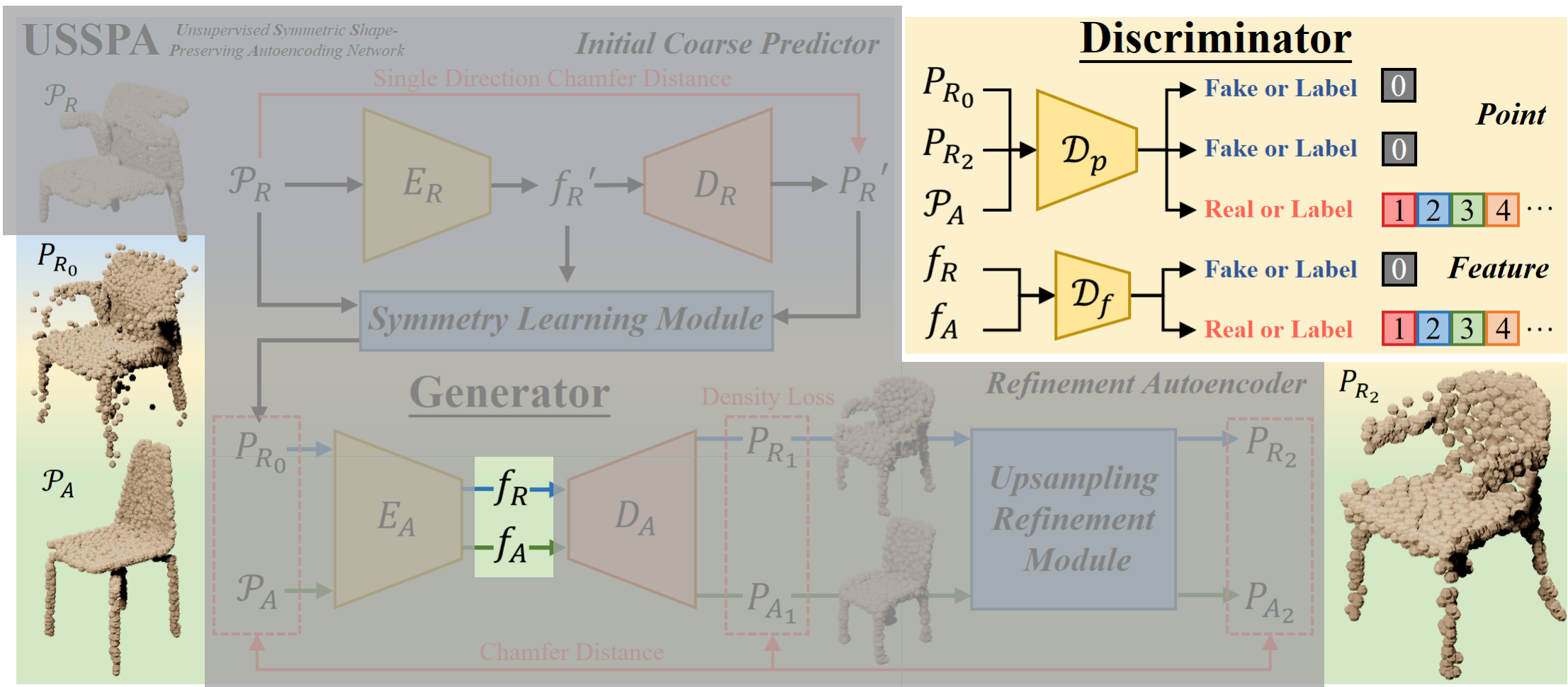
Our Method



Our Method



Our Method





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Evaluation

Unpaired:

- A classifier.

Our new evaluation method:

- We build a dataset from ScanNet (real scene data) and ShapeNet (artificial) utilizing the annotations of Scan2CAD.
- The dataset contains real scene partial point clouds and paired ground truths that are only used for evaluation in our experiments.

Comparison & Results

Table 1. Point cloud completion comparison on our dataset in terms of L1 Chamfer Distance $cd^{l1} \times 10^2$ (lower is better). All the methods are trained with our dataset and the unsupervised methods including ours are trained on single category data. Boldface denotes the best among unsupervised methods in Tables 1, 2 and 3.

	Method	AVG	chair	table	trash bin	TV	cabinet	bookshelf	sofa	lamp	bed	tub
<i>Sup.</i>	PoinTr [34]	14.37	13.65	12.52	15.26	12.69	17.32	13.99	12.36	17.05	15.13	13.77
	Disp3D [23]	7.78	6.24	8.20	7.12	7.12	10.36	6.94	5.60	14.03	6.90	5.32
	TopNet [19]	7.07	6.39	5.79	7.40	6.26	8.37	7.02	5.94	8.50	7.81	7.25
<i>Unsup.</i> <i>OptBased</i>	ShapeInv [36]	21.39	17.97	17.28	33.51	15.69	26.26	25.51	14.28	16.69	32.33	14.43
<i>Unsup.</i>	Unpaired [32]	10.47	8.41	7.52	12.08	6.72	17.45	9.95	6.92	19.36	10.04	6.22
	Cycle4 [24]	11.53	9.11	11.35	11.93	8.40	15.47	12.51	10.63	12.25	15.73	7.92
	Ours	8.56	8.22	7.68	10.36	7.66	10.77	7.84	6.14	11.93	8.20	6.75

Table 2. Comparison on our dataset trained with single category and multi-category data in terms of L1 Chamfer Distance $cd^{l1} \times 10^2$ (lower is better) and F-scores $F_{score}^{0.1\%} \times 10^2$, $F_{score}^{1\%} \times 10^2$ (higher is better). “Ours” and “Ours(classifier)” denote our method with probability-guided and classifier-guided discriminators, respectively.

Method	single category		multi-category		
	$\uparrow F_{score}^{0.1\%}$	$\uparrow F_{score}^{1\%}$	$\downarrow cd^{l1}$	$\uparrow F_{score}^{0.1\%}$	$\uparrow F_{score}^{1\%}$
PoinTr [34]	-	-	14.37	18.35	80.41
Disp3D [23]	-	-	7.78	30.29	78.26
TopNet [19]	-	-	7.07	12.33	80.37
ShapeInv [36]	15.58	66.53	19.35	16.98	69.66
Unpaired [32]	12.20	64.33	10.12	10.86	66.68
Cycle4 [24]	9.98	60.14	12.00	8.61	56.57
Ours	17.49	73.41	8.96	16.88	72.31
Ours(classifier)	-	-	8.76	17.12	73.75

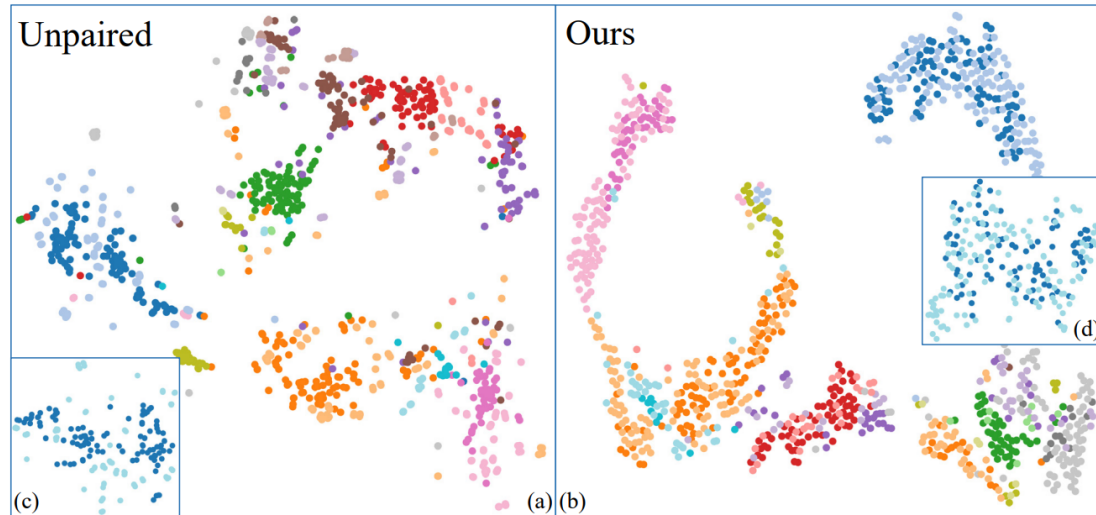
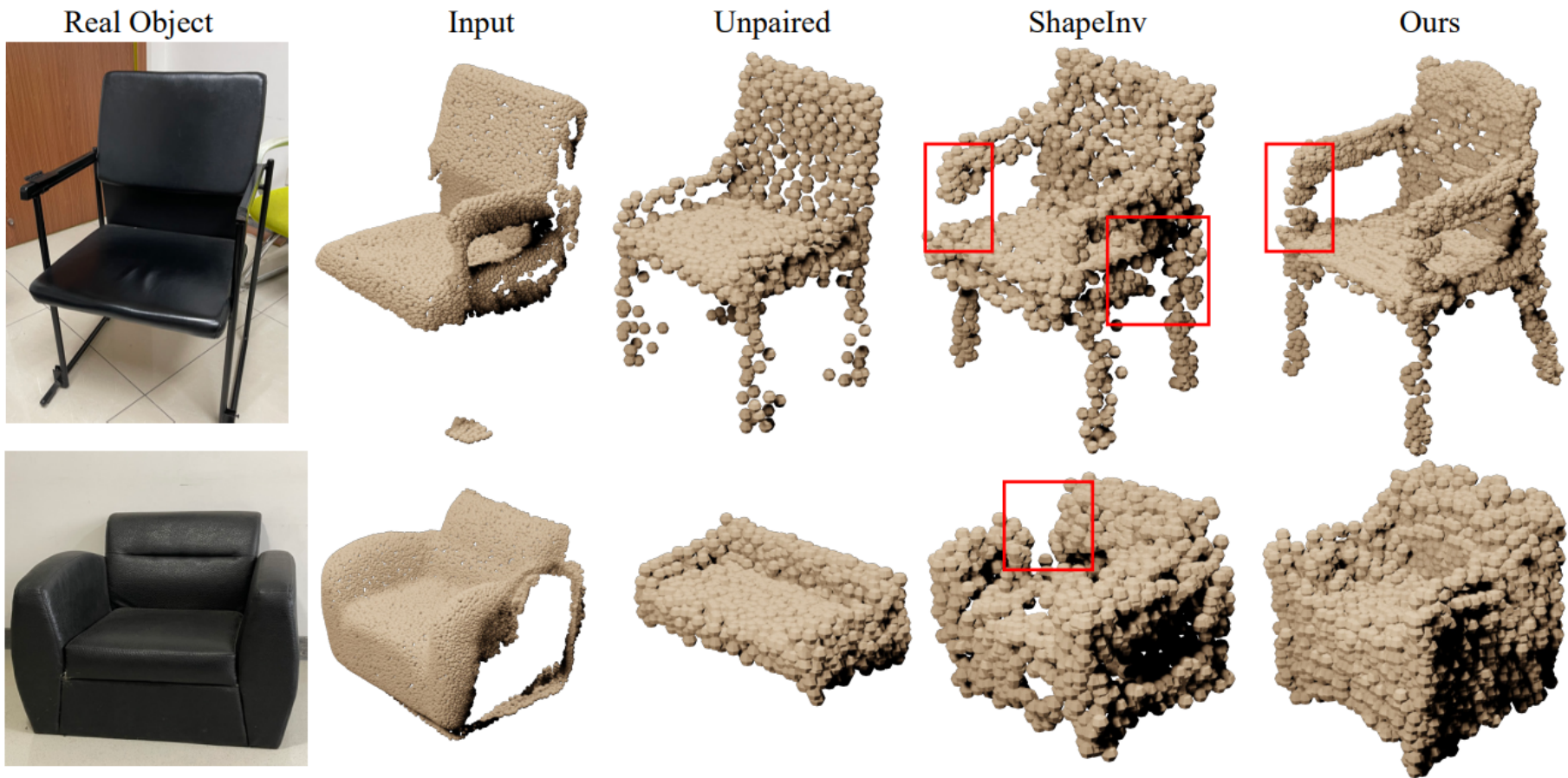


Figure 8. Visualization of t-SNE results of the latent codes by Unpaired [32] and our method. (a) and (b) are the results on multi-category, where different colors denote different categories. Dark and light denote real scene data and artificial data respectively. (c) and (d) are the results on the chair category only.

Real Objects





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Conclusion

An end-to-end unsupervised network for completion of real scene point cloud objects.

- Symmetric shape-preserving.
- Multi-category.
- More accurate and uniform points.

A new evaluation method for real scene point cloud completion.



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THANK YOU!

