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Auto3DSG

Autoencoding for 3D Scene Graph Learning via Object-Level Scene Reconstruction

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ICCV23 PARIS
SG2RL 2023

Introduction

Problem: Large-scale datasets with high-quality relationship labels are scarce for 3D scene graph learning

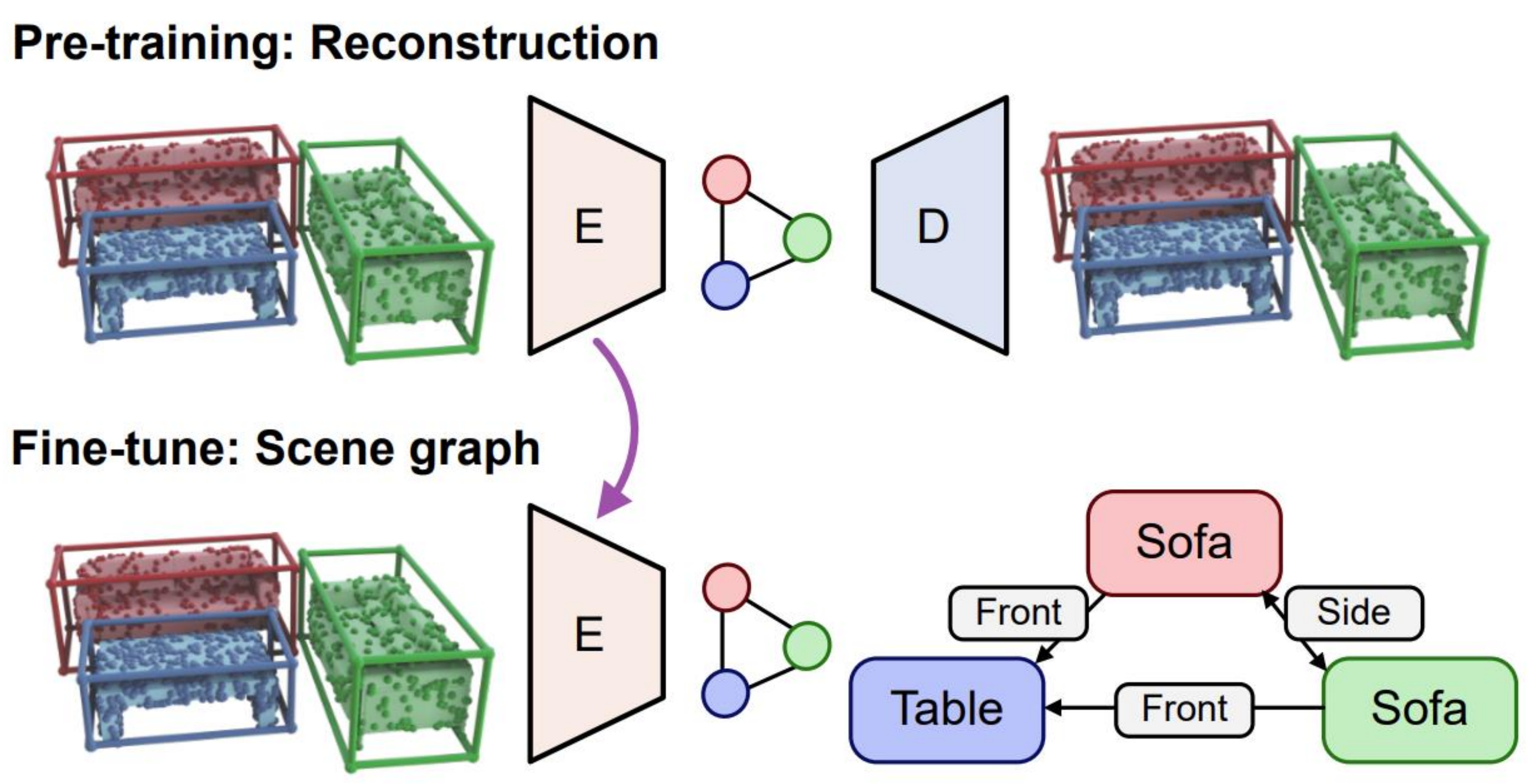
Goal: Reduce the need of labels, by leveraging self-supervised learning without requiring relationship labels

Contributions:

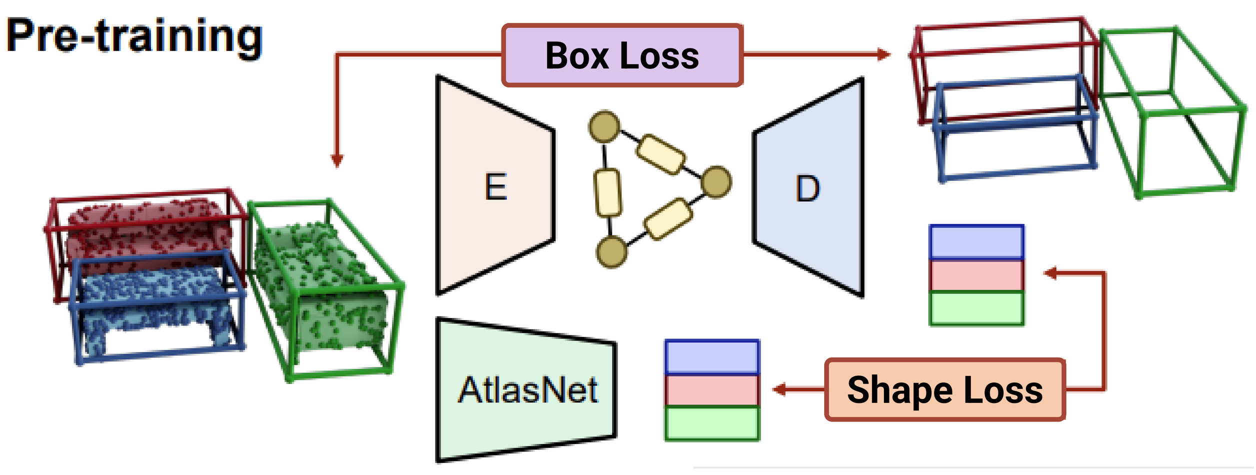
- ✔ Novel autoencoder-based pre-training which is trainable on 3D datasets without scene graph labels such as ScanNet
- ✔ Auto3DSG boosts 3D scene graph prediction performance
- ✔ Auto3DSG outperforms fully supervised methods on 3DSSG
- ✔ Improved label-efficiency: Only few samples are required to outperform the same model trained from scratch

Key Idea

Increase label efficiency and available data for scene graph learning by self-supervised pre-training using reconstruction

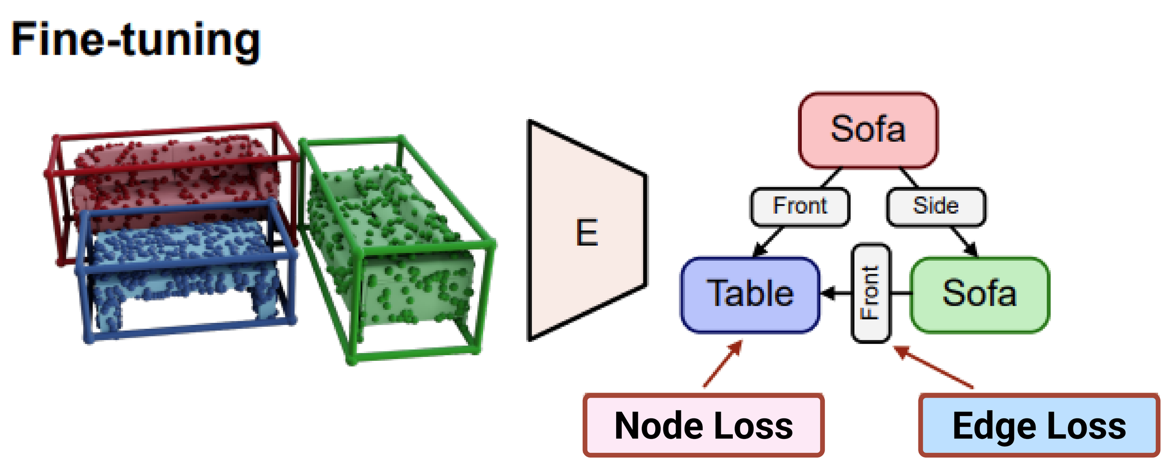


Method



Use of a **bounding box loss** to learn to reconstruct the overall layout of the scene.

Use of a **latent shape loss** to learn the shapes of objects encoded by a pre-trained **AtlasNet**.

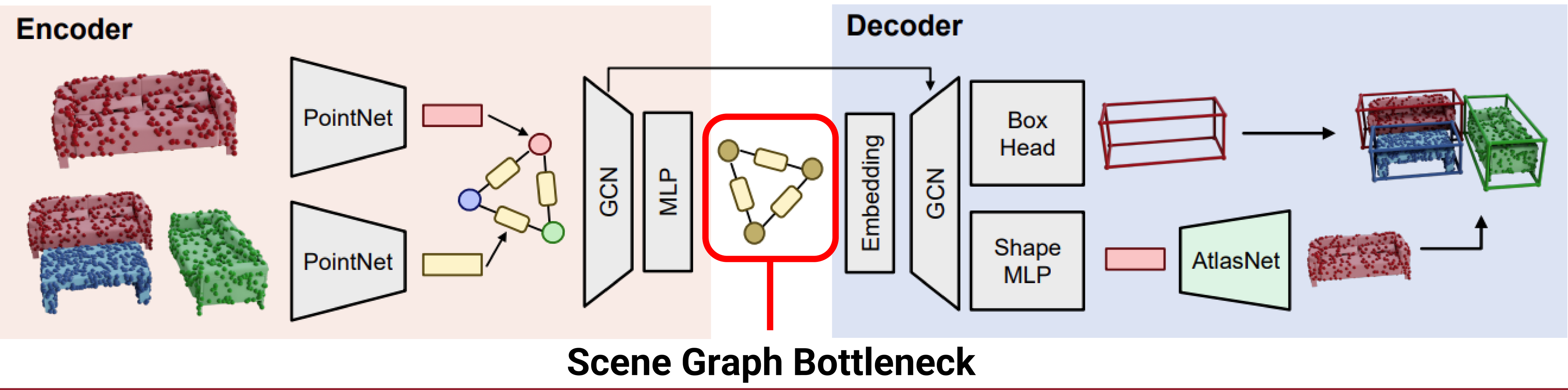


The **decoder** is discarded for fine-tuning.

The **encoder** is fine-tuned on a smaller scene graph dataset with a supervised loss for **objects** and **predicates**.

An initial feature graph is constructed from a point cloud by encoding each instance and pairs of instances using a PointNet.

The features are refined into a scene graph bottleneck using a GCN with message passing.

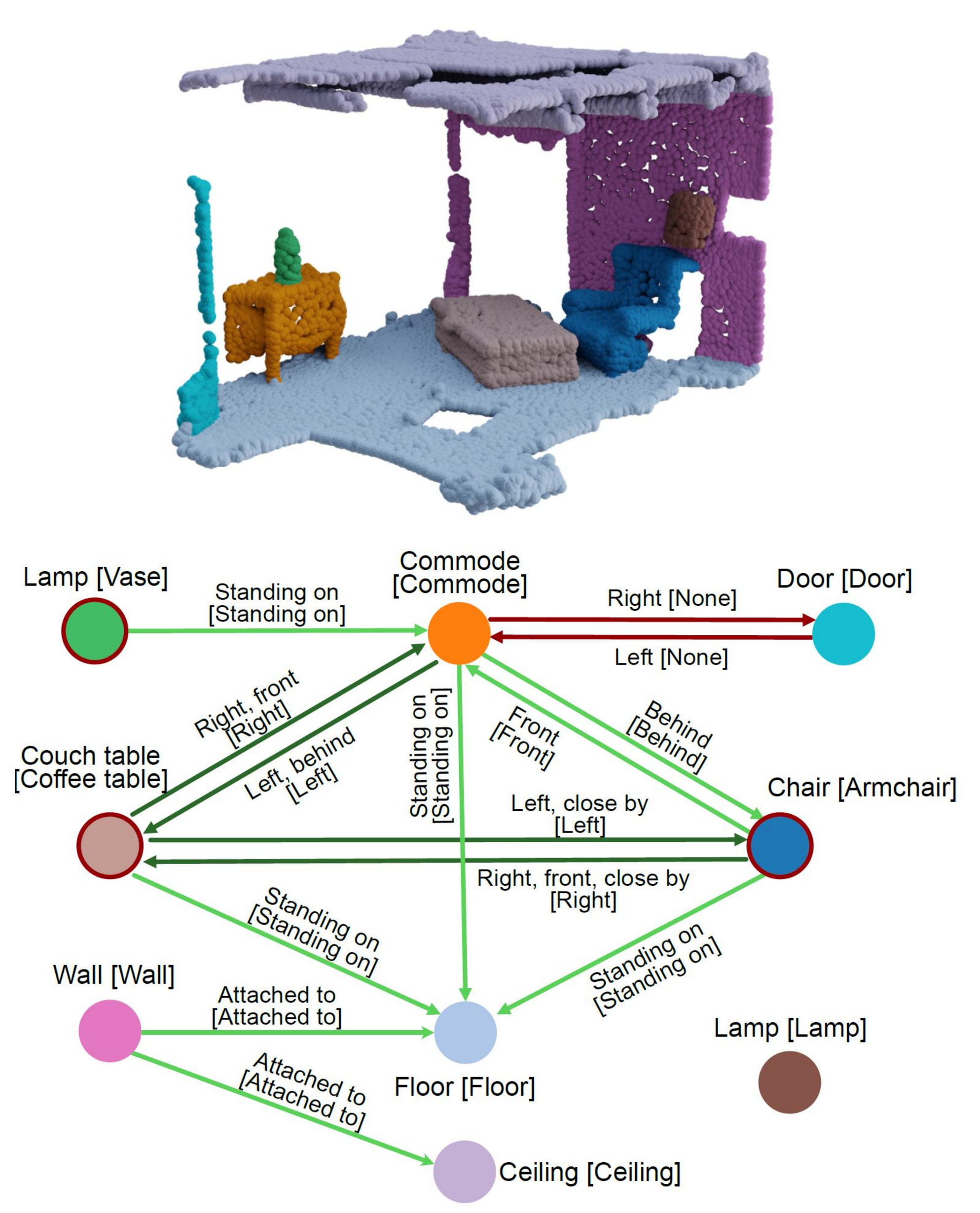


From the scene graph bottleneck, predicated shape codes are decoded by a pre-trained **AtlasNet**.

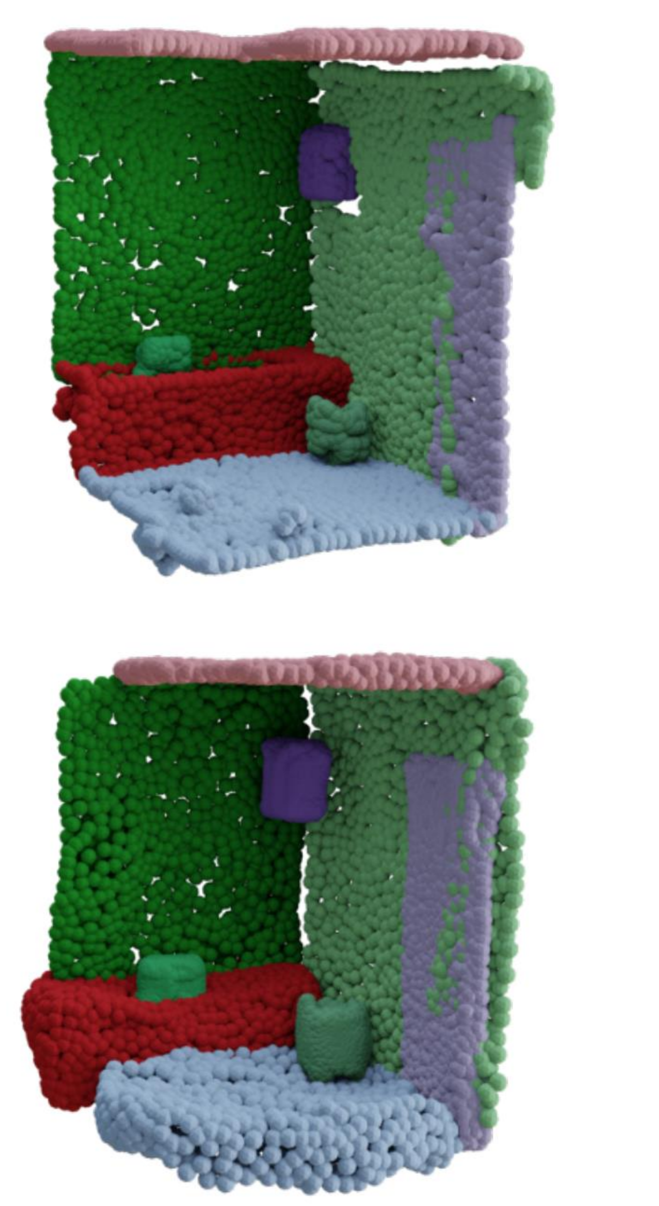
The predicted shapes are placed within the predicted bounding boxes.

Qualitative Results

3D Scene Graph Prediction



3D Scene Reconstruction



3DSSG Evaluation

	Object		Predicate		Relationships	
	R@5	R@10	R@3	R@5	R@50	R@100
3DSSG	0.68	0.78	0.89	0.93	0.40	0.66
SGFN	0.70	0.80	**0.97**	**0.99**	0.85	0.87
Auto3DSG	**0.80**	**0.87**	**0.97**	**0.99**	**0.89**	**0.91**

* More baseline results can be found in the paper

Label-efficiency