SSR: Semi-supervised Soft Rasterizer for single-view 2D to 3D Reconstruction
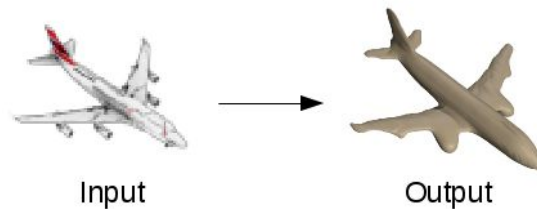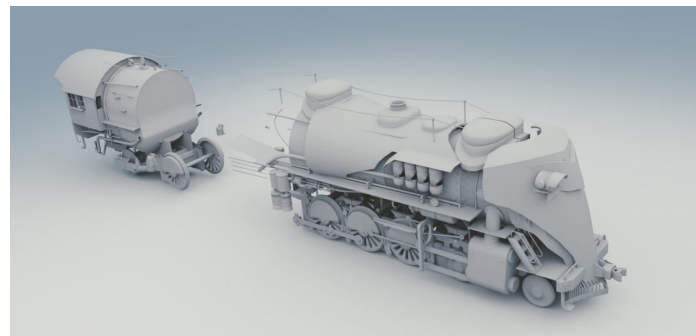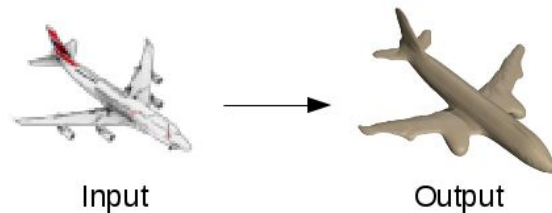
Issam Laradji, Pau Rodriguez, David Vazquez, Derek Nowrouzezahrai

Input → Output

3D reconstruction is impactful

- Applications
  - Autonomous driving, robotics, remote sensing, and medical treatment

- Challenges
  - Manually modelling 3D objects requires a significant amount of human effort.

- **Any attempt at reducing labeling effort is impactful**


Input → Output

Leverage unlabeled data

- Some differentiable renderers only require viewpoints
    - A viewpoint represents the distance, elevation, and azimuth from a set vantage point

- However,
    - viewpoints might not be readily available
    - And their collection is not trivial

- **Use a semi-supervised learning approach to leverage a large set of unlabeled images**
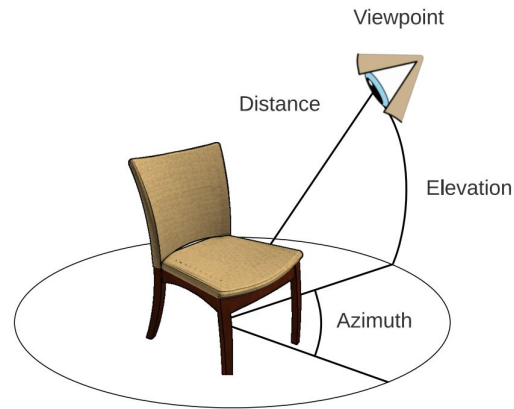
Contributions

- A novel framework that leverages unlabeled samples for learning to construct 3D meshes

- Extends SoftRas [ICCV'2019] with SiamVP

  - a siamese network that is trained to predict whether two images have the same viewpoint

- Huge boost in performance

  - IoU on ShapeNet for different amounts of labeled data

SSR: Semi-supervised Soft Rasterizer for single-view 2D to 3D Reconstruction
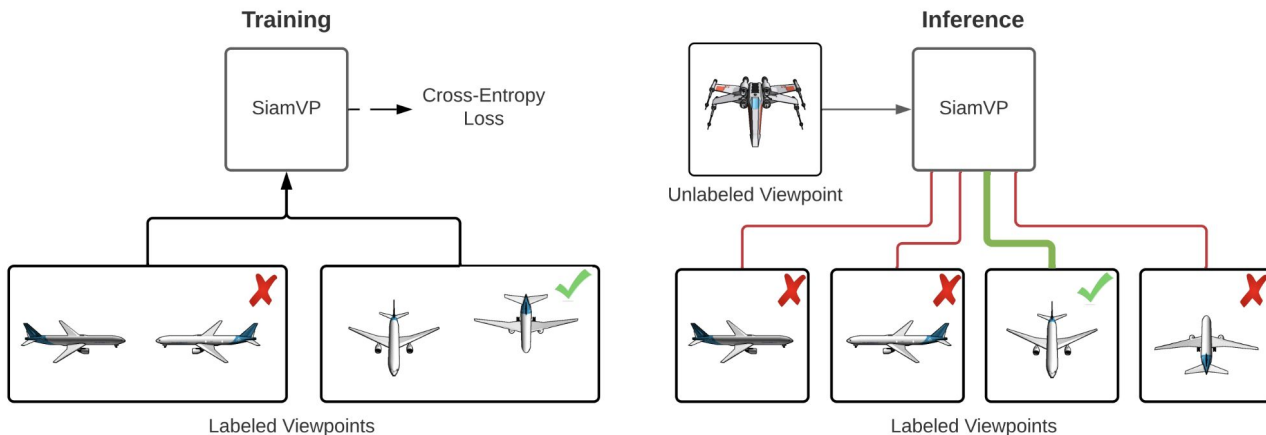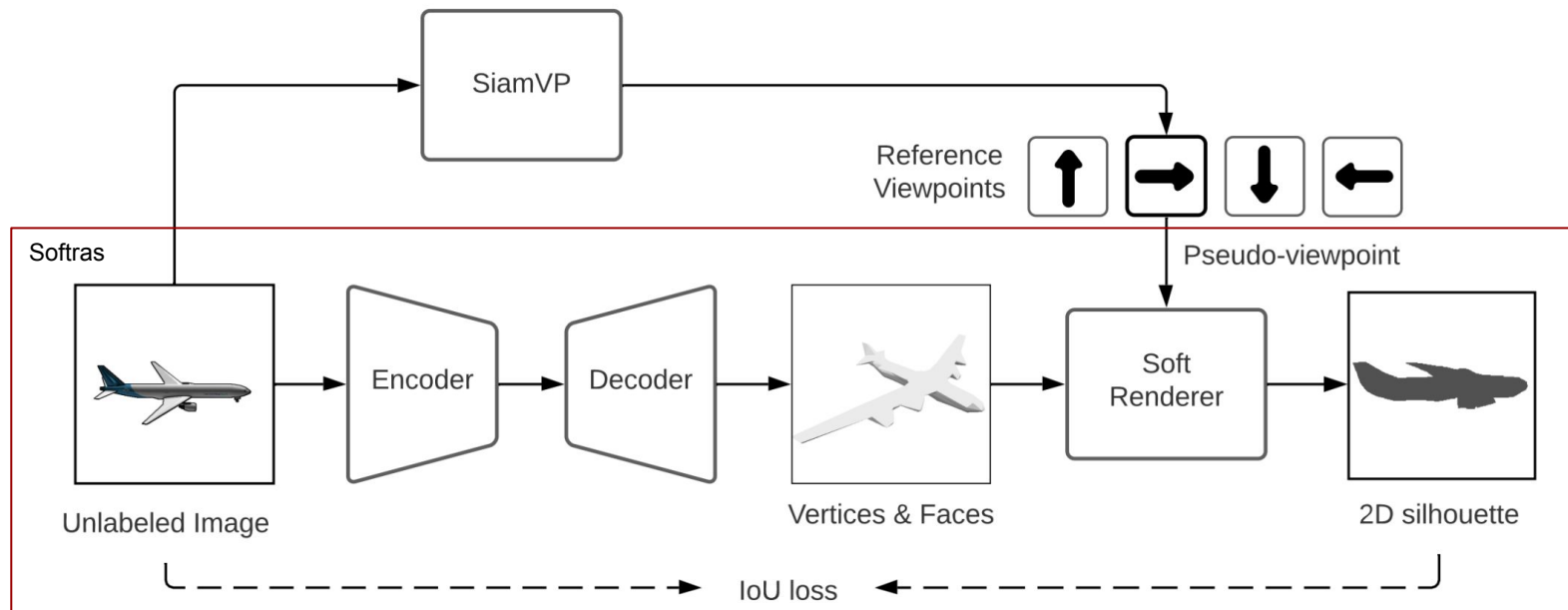

Train on the labeled data
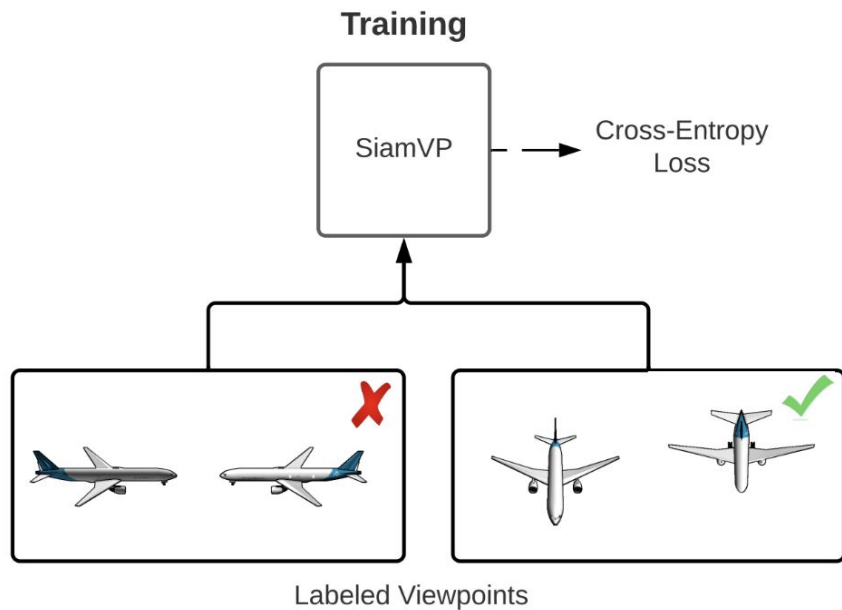
Predict Viewpoints for the unlabeled
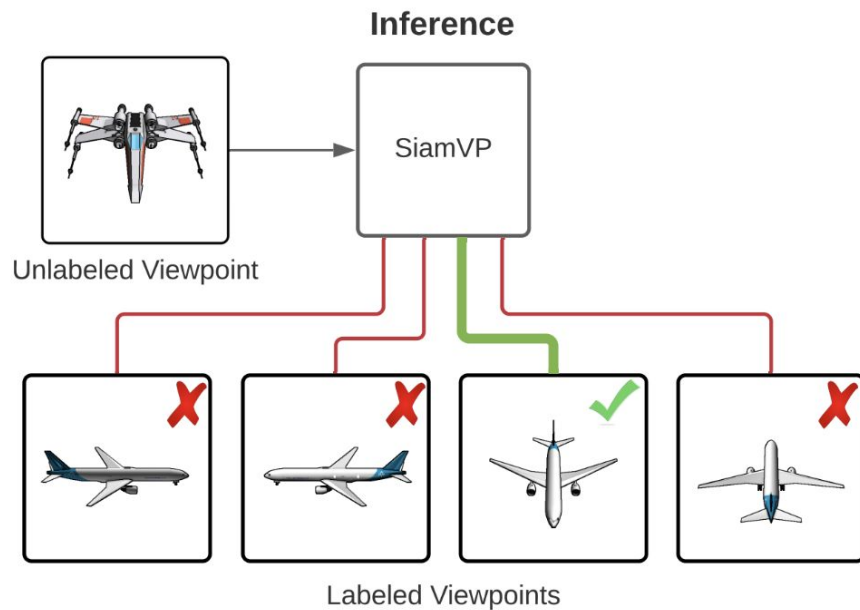
Training pipeline

$$\mathcal{L}_s = 1 - \frac{||\hat{I}_s * I_s||_1}{||\hat{I}_s + I_s - \hat{I}_s * I_s||_1}$$

Experimental Results

Table 2. IoU results for various objects of ShapeNet, where N is the number of labeled examples.

Method	N	Plane	Bench	Cabinet	Car	Chair	Display	Lamp	Speaker	Rifle	Sofa	Table	Phone	Vessel	Mean
MVC [37]	0	0.38	-	-	0.48	0.35	-	-	-	-	-	-	-	-	-
SoftRas	2	0.42	0.24	0.39	0.6	0.26	0.33	0.17	0.38	0.44	0.38	0.17	0.57	0.28	0.36
SSR (ours)	2	0.55	0.44	0.48	0.75	0.37	0.5	0.27	0.45	0.63	0.53	0.27	0.71	0.53	0.50

Examples from the dataset

Performance as more unlabeled are used
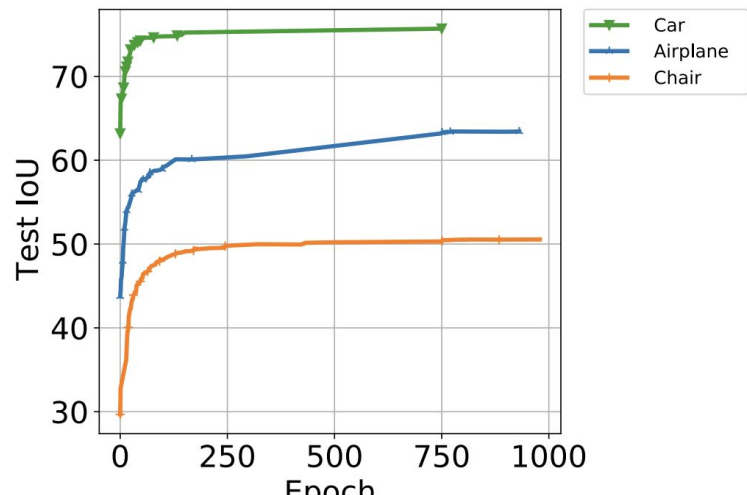
Conclusions

Single-view 2D to 3D Reconstruction

1

A Simple module to leverage unlabeled examples

2

Only few examples need to be labeled with viewpoints

3

Achieved huge boost in performance for 3D reconstruction

GitHub Code:
https://github.com/IssamLaradji/SSR