Atlasnet : A Papier-Mâché Approach to Learning 3D Surface Generation

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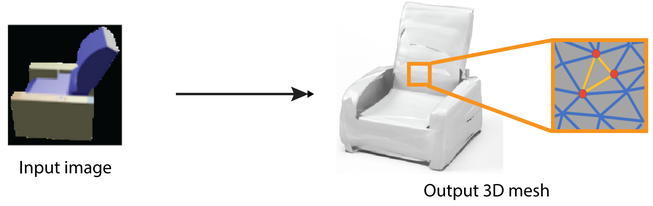
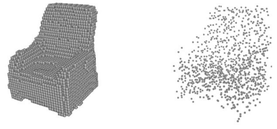
http://imagine.enpc.fr/~groueixt/atlasnet/

Motivation

Goal: Generate directly a mesh with a neural network



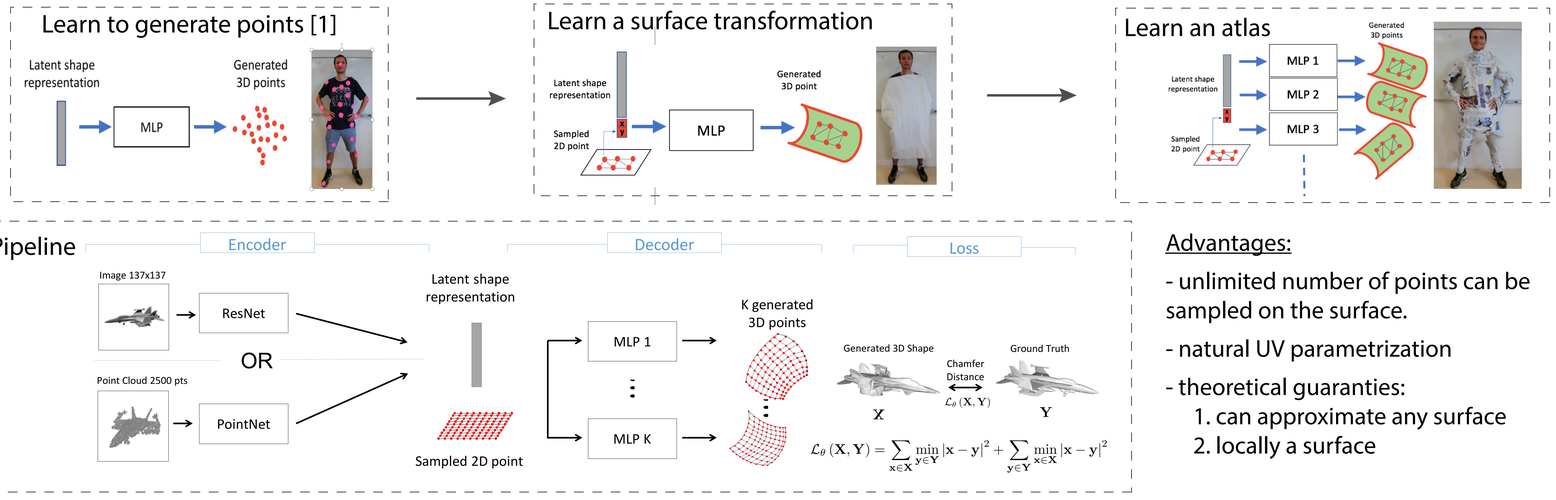
Previous work: mainly generate voxels and points



Challenges:

1. How to generate a mesh with a neural network?
2. How to generate beyond a fixed set of points?

Key Ideas

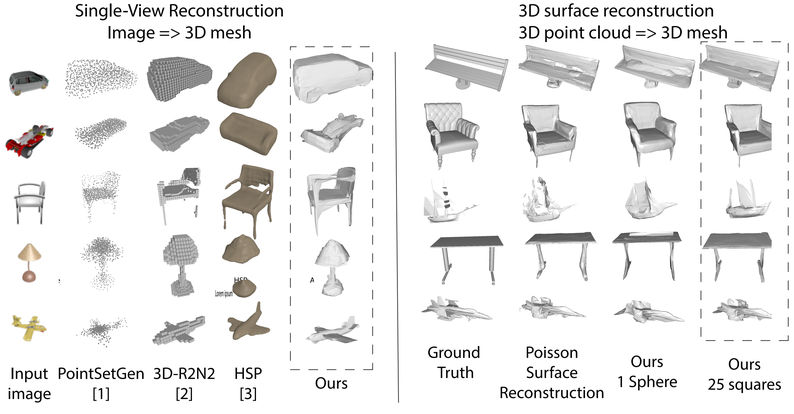


Advantages:

- unlimited number of points can be sampled on the surface.
- natural UV parametrization
- theoretical guaranties:
  1. can approximate any surface
  2. locally a surface

Results

Qualitative results



Quantitative results

Single-View Reconstruction

	pla.	ben.	cab.	car	cha.	mon.	lam.	spe.	fir.	cou.	tab.	cel.	wat.	mean
D	2.91	4.39	6.01	4.45	7.24	5.95	7.42	10.4	1.83	6.65	4.83	4.66	4.65	5.50
PSG CD	3.36	4.31	8.51	8.63	6.35	6.47	7.66	15.9	1.58	6.92	3.93	3.76	5.94	6.41
Ours CD	2.54	3.91	5.39	4.18	6.77	6.71	7.24	8.18	1.63	6.76	4.35	3.91	4.91	5.11
Ours Metro	1.31	1.89	1.80	2.04	2.11	1.68	2.81	2.39	1.57	1.78	2.28	1.03	1.84	1.89

Quantitative Auto-encoder results

Method	CD	Metro
Oracle 2500 pts	0.85	1.56
Oracle 125K pts	-	1.26
Points baseline	1.91	-
Points baseline + normals	2.15	1.82 (PSR)
Ours - 1 patch	1.84	1.53
Ours - 1 sphere	1.72	1.52
Ours - 5 patches	1.57	1.48
Ours - 25 patches	1.56	1.47
Ours - 125 patches	1.51	1.41

Quantitative Generalization results

Category		Points baseline	Ours 1 patch	Ours 125 patches
chair	LOO	3.66	3.43	**2.69**
	All	1.88	1.97	**1.55**
car	LOO	3.38	2.96	**2.49**
	All	1.59	2.28	**1.56**
watercraft	LOO	2.90	2.61	**1.81**
	All	1.69	1.69	**1.23**
plane	LOO	6.47	6.15	**3.58**
	All	1.11	1.04	**0.86**

Applications

Optimising texture maps

Shape interpolation

Follow-up : « Shape correspondences from learnt template-based parametrization»

State of the art results on FAUST inter correspondences, available on ArXiv

Code and results in the project webpage

[1] A point set generation network for 3D object reconstruction from a single image, Fan et al. 2017
[2] 3D-R2N2: A unified approach for single and multi-view 3D object reconstruction, Choy et al. 2016
[3] Hierarchical surface prediction for 3D object reconstruction, Häne et al. 2017