Pose from Shape: Deep Pose Estimation for Arbitrary 3D Objects

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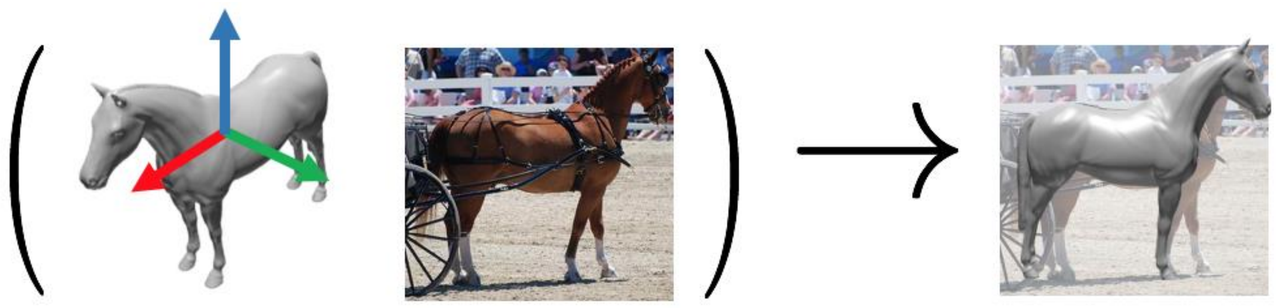
http://imagine.enpc.fr/~xiaoy/PoseFromShape/

Motivation

Task: Pose estimation



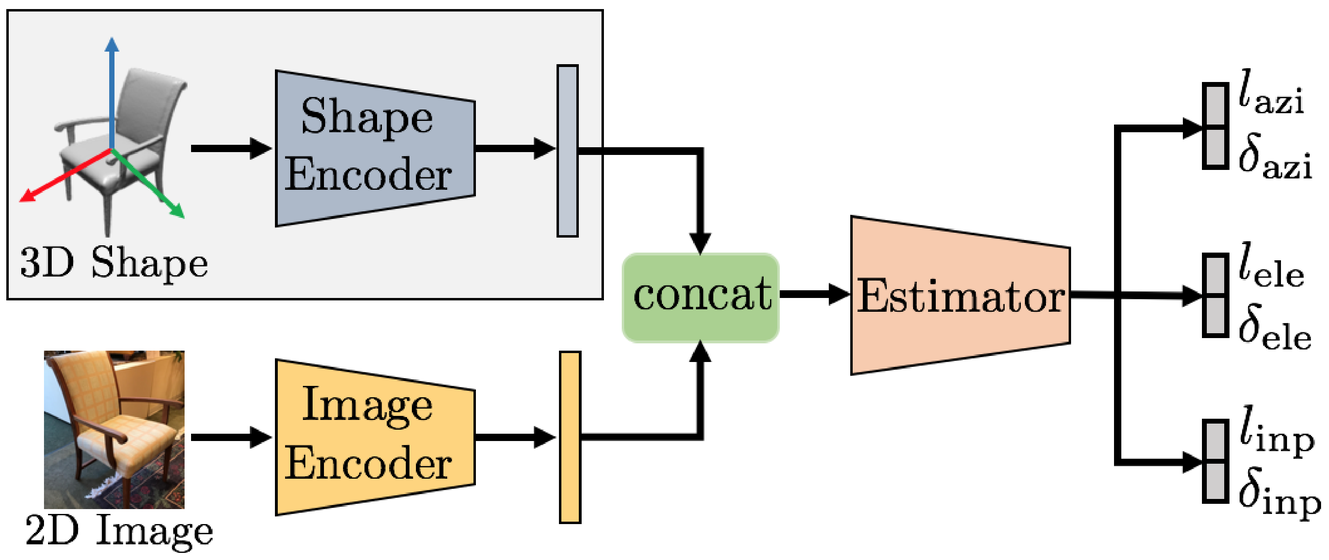
Challenge: Testing on unseen arbitrary objects

Key findings:

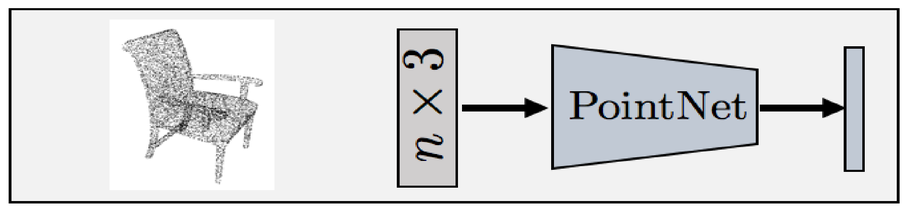
- Using object shape improves pose estimation
- Using object shape enables category generalization

Key Ideas

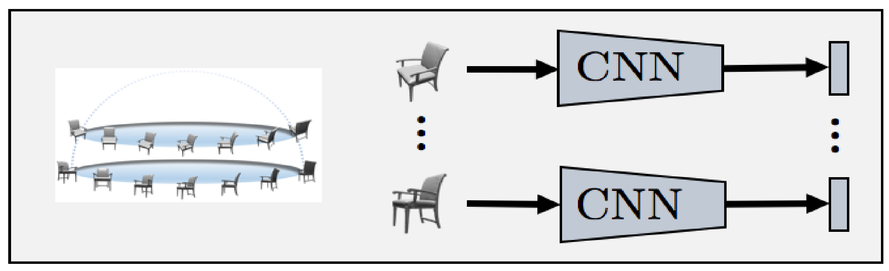
Pose estimation from shape and image



Encode the shape and orientation



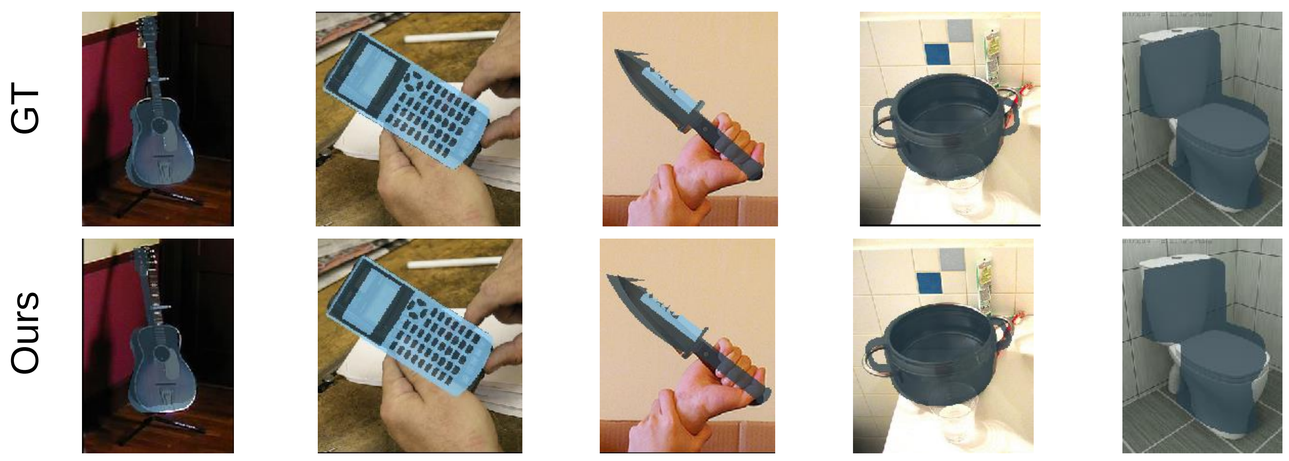
(a) Point cloud



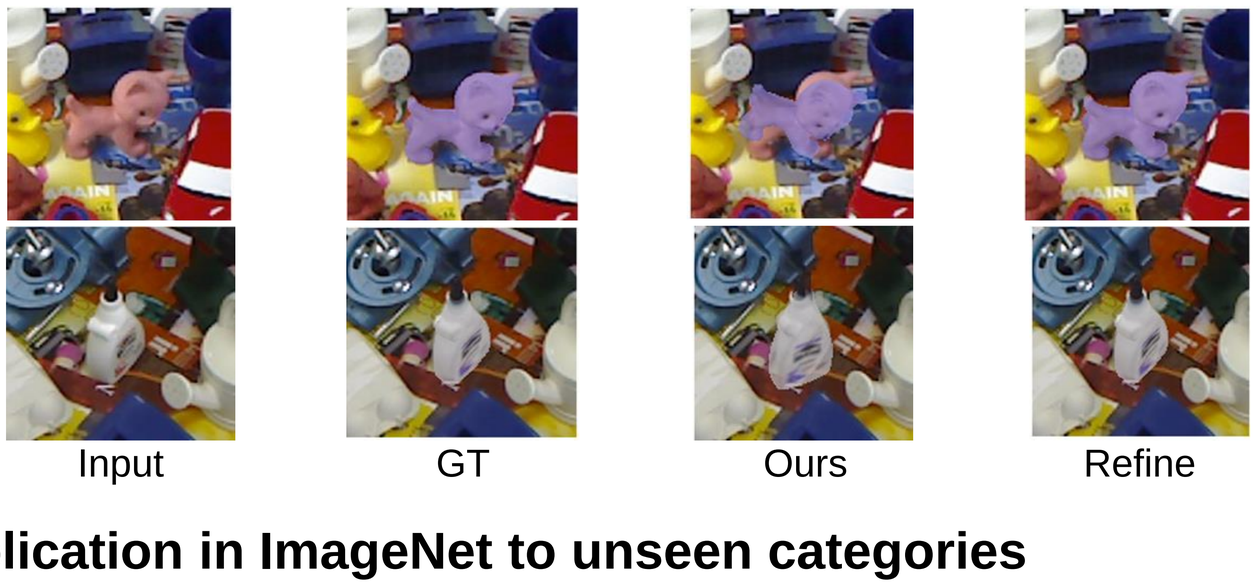
(b) Rendered views

Results

Results on unseen objects of ObjectNet3D



Results on unseen objects of LINEMOD

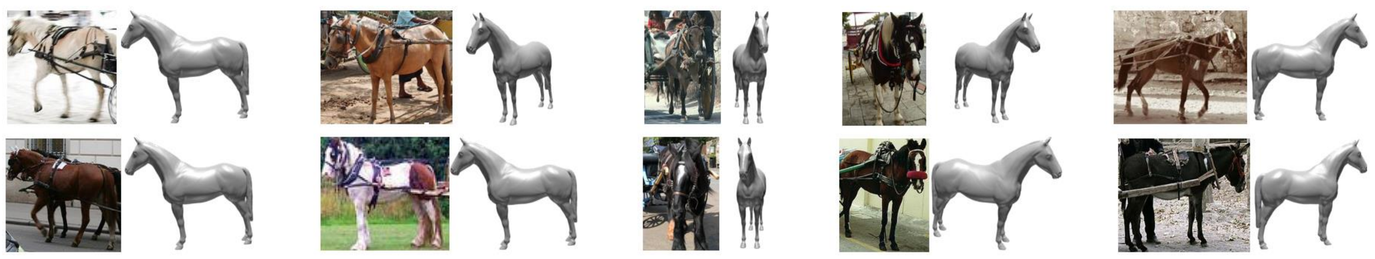


Quantitative results

ObjectNet3D (**supervised category**)	Accuracy
StarMap [4]	56
Without shape (ours)	64
With point cloud (ours)	68
With rendered views (ours)	**73**
ObjectNet3D (**novel category**)	Accuracy
StarMap [4]	42
Without shape (ours)	50
With point cloud (ours)	59
With rendered views (ours)	**62**

Pascal3D+ (**category-specific**)	Accuracy	Error
Viewpoints and keypoints [5]	80.75	13.6
Render for CNN [6]	82.00	11.7
Grabner [7]	83.92	10.9
Pascal3D+ (**category-agnostic**)	Accuracy	Error
Grabner [7]	81.33	11.5
StarMap [4]	81.67	12.8
With rendered views (ours)	**82.66**	**10.0**

Application in ImageNet to unseen categories



Contributions:

- A simple network combining shape and image
- Performance boost on seen and unseen categories
- Application to arbitrary objects "*in-the-wild*"

[1] ObjectNet3D: A large scale database for 3D object recognition. ECCV (2016)
[2] Beyond PASCAL: A benchmark for 3D object detection in the wild. WACV (2014)
[3] Model based training, detection and pose estimation of texture-less 3d objects in heavily cluttered scenes. ACCV (2012)
[4] Starmap for category- agnostic keypoint and viewpoint estimation. ECCV (2018)
[5] Viewpoints and keypoints. CVPR (2015)
[6] Render for CNN: Viewpoint estimation in images using CNNs trained with rendered 3D model views. ICCV (2015)
[7] 3D pose estimation and 3D model retrieval for objects in the wild. CVPR (2018)