

Robust 6D-Pose-Estimation using Pointnet

6D-pose estimation of an object in a RGB image refers to the task of estimating the six degrees of freedom (6DOF) of an object in a 3D space. This involves determining the 3D rotation and translation to orient the 3D object into the 2D image plane.

Algorithm

- Load image
- Get/Predict Segmentation Mask
- Get point cloud using the depth image
- Load 3D model
- Estimate 6D parameters for each object using either
 - Chamfer + ICP
 - Pointnet
 - Pointnet + ICP
 - Custom
- Render Result

Contributions

- End-to-end differentiable pipeline for ICP
- Mesh laplacian for consistency (can also use a ED Warpfield)
- Use point net to predict a binary mask on the point cloud and mesh samples vertices. Only
 - $P(z_p=\{0,1\} \mid \text{Point cloud, mesh})$
 - We do not require the occluded surface of the complete object for ICP, can also remove it.
 - For now additional constraint is that $P(z_p=1 \mid \text{Pcd, mesh}) = 1$ for point cloud since it is visible.
 - Note there lies exist a particular 3D to 2D projection matrix that would give the desired result.

ICP Input:

1. XYZ, RGB, L2 skeleton radius (pseudo medial axis)

A. Installation

1. Download the codebase. `git clone --recursive https://github.com/shubhMaheshwari/6D-Pose-Estimation`
2. Download the dataset.
3. Install python packages. `pip install torch torchvision tqdm`
4. Optional: Download blender.

Note- Raise an issue if you are facing trouble installing any of the above packages.

B. Inference

1. Update dataset path in `src/utils.py`

2. Get prediction `python3 src/pose_estimation.py` # For complete test dataset to get metrics Or `python3 src/pose_estimation.py \ <sample-filepath> # Specific file --force` or `-f # Rewrite results --image # Location to save images/plots`

C. References

- Pointnet @article{qi2016pointnet, title={PointNet: Deep Learning on Point Sets for 3D Classification and Segmentation}, author={Qi, Charles R and Su, Hao and Mo, Kaichun and Guibas, Leonidas J}, journal={arXiv preprint arXiv:1612.00593}, year={2016} }