Point Cloud Occupancy with Dynamic Planes

Computer Vision Course Project

Master’s Degree in Artificial Intelligence and Robotics

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TODO

- check UNet
- reconstruction
- bilinear interpolation
- metrics
- slides

What is the Addressed Problem

- In this work we are interested in performing the reconstruction of point clouds.
- The input noisy point clouds are encoded into per-point features that are projected onto multiple 2D dynamic planes.
- Then we predict the occupancy values of each point in order to find the surface of the shapes.
- The original paper applied this study to the ShapeNet Dataset.

Insert 3 images of the same sample

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FAUST Dataset

This Dataset is composed by high-resolution human scans of 10 different bodies in 30 different poses.

- The test set is composed by 200 scans, while the training has 100 scans.
- Each of the samples inside the training set has a corresponded ground truth alignment (registration)
- The training set has been partitioned again in order to obtain train and validation sets
- About 80 % fo the initial training set has been used for training, while the other 20 % has been used for validation

Examples from the Dataset

Insert here 1/2 images of different bodies with differente poses. Registration + Clouds

Sampling

The perfomances of the Architecture varies with respect to the Sampling technique used. The author of the paper have used a Uniform Sampling, while in my case I have tried different approaches, each with different pros and cons:

- Random Sampling
- Importance Sampling
- Uniform Sampling

Examples of Sampled Clouds

Insert here images of the sampled point cloud in the 3 Cases + Real cloud

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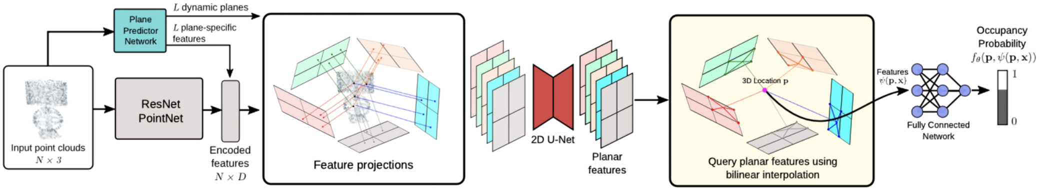
Architecture design

3 Architecture

The Architecture is characterized by an Encoder-Decoder structure:

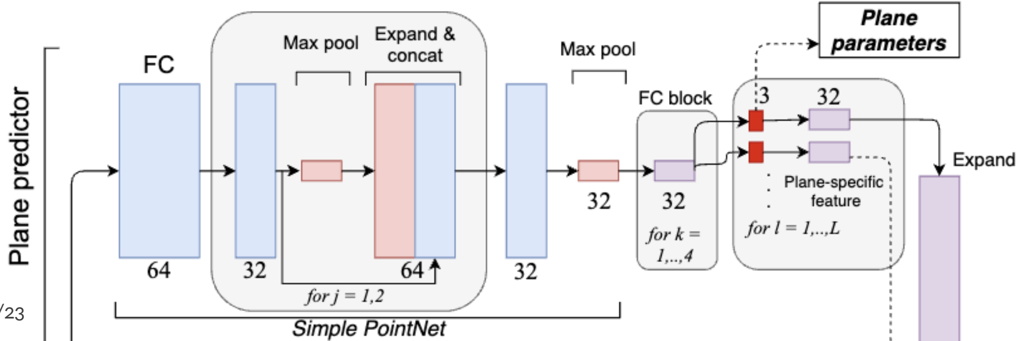
- Encode the input clouds into 2D Feature Planes
- Decode these features into occupancy probabilities



Encoder

The Encoder is composed by :

- ResNet PointNet
- Plane Predictor
- UNet



The Dec is composed by:

- Feature Projection and Bilinear Interpolation
- Occupancy Network

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Reconstruction Phase

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5 Results

Metrics

In order to evaluate the performance of our model, the following metrics have been used:

- Chamfer Distance :
  $CD(A,B) = \frac{1}{|A|}\sum_{a\in A}\min_{b\in B}\|a-b\|_2^2 + \frac{1}{|B|}\sum_{b\in B}\min_{a\in A}\|b-a\|_2^2$
- IOU : $IoU(A',B') = \frac{|A'\cap B'|}{|A'\cup B'|}$
- F-Score:

Add each formula

Loss Performances

Insert here plots

Metrics Performances

Insert here just a table with metrics, gpu usage various types of sampling

Insert here just some images about reconstructions

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Possible Changes and Future Improvements

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