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Photogrammetry: From Images to 3D point clouds

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Deep learning and 3D point clouds

Introduction

After researching papers on photogrammetry and point clouds, I find there are many technologies related to 3D point clouds: machine learning, generative methods, deep learning and so on. Point clouds are also widely used in many applications such as auto navigation. This paper focuses on introducing how deep learning realizes 3D point clouds.

Currently, more and more people pay attention to cloud points on deep learning. Point cloud processing involves many branches such as 3D shape classification, 3D object detection and tracking, 3D point cloud segmentation, 3D point cloud registration, 3D reconstruction and 3D data. Throughout several years' research, to solve various problems, researchers have released many public datasets such as ModelNet, ScanObjectNN, ShapeNet, PartNet, S3DIS, Semantic3D, ApolloCar3D, and so on. The whole system is so large and complex that this paper mainly introduces 3D shape classification, 3D Point Cloud Segmentation and 3D Object Detection with some important datasets.

3D shape classification

There are mainly three methods realizing 3D classification: multi-view based Methods, volumetric-based Methods and point-based Methods. Datasets based on the multi-view based

methods include Multi-view Convolutional Neural Networks for 3D Shape Recognition (MVCNN) and MHBN. They integrate different multi-viewed things into a common descriper. Volumetric-based Methods use VoxNet and point-based methods use Pointwise MLP Methods.

3D Object Detection

For 2D object detection, the camera needs to scan every image and find the target that matches the setting. Similar to object detection in 2D, 3D object detection methods need to scan the whole object nearby and find the target. It can be divided into two categories: region proposal-based methods and single-shot methods. Region Proposal-based Methods can further be divided into three categories: multi-view based, segmentation-based and frustum-based methods. Single Shot Methods involve BEV-based Methods, Discretization-based Methods and Point-based Methods. Main datasets are BirdNet and PointNets.

3D Point Cloud Segmentation

3D Point Cloud Segmentation is mainly semantic segmentation whose goal is to segment the points into subsets based on their semantics. There are four modes of semantic segmentation: projection-based, discretization-based, point-based, and hybrid methods. Both projection and discretization-based methods convert the point cloud into intermediate canonical representations such as multi-view, spherical, volumetric, fully automatic lattice, and hybrid representations. Projection-based Methods include Multi-view Representation and Spherical Representation. Discretization-based Methods are divided into Dense Discretization Representation and Sparse Discretization Representation. For other methods, point-based methods include Pointwise MLP Methods, Point Convolution Methods, RNN-based Methods and Graph-based Methods. Expect

semantic segmentation, there are also part segmentation and insane segmentation which include Proposal-based Methods and Proposal-free Methods

Reference

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