Object Detection in Agricultural Fields using 3D LiDAR Point Cloud

Supervisors: Zhongkai ZHANG and Roland LENAIN
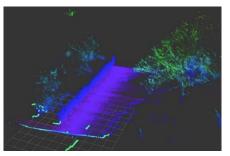
Romea team, INRAE in Clermont-Ferrand

Research team

The ROMEA (RObotique et Mobilité pour l'Environnement et l'Agriculture) team conducts research in robotics for the development of autonomous machines in natural environments. ROMEA is developing perception and control approaches allowing robots to adapt to their environment in a safe manner. The work carried out within ROMEA covers various aspects, from the development of new sensors to the development of intelligent algorithms for reconfiguring robotic behaviour. ROMEA is a INRAE team located in Clermont-Ferrand. INRAE is the French National Research Institute for Agriculture, Food and Environment. Because of its size and research outcome, INRAE is ranked number one in the world for research on agriculture, food, and the environment. Clermont-Ferrand is a middle-size city in the center of France. Living in Clermont-Ferrand enjoys a high quality of life and a low cost of rent.

Objective

The equipment of 3D Lidar sensor for mobile robot navigation allows to obtain real-time point clouds. Compared with 2D RGB image, 3D point cloud describes more information of the environment. However, object detection from 3D point cloud [1] is more changing than their 2D counterpart, especially for disordered point cloud. Object detection using supervised learning methods needs a huge annotated data, and when the background changes, new labels should be annotated again. Generative Adversarial Networks (GAN) [2] have been proposed to reduce the annotation task by human for 2D image segmentation [3]. Although GANs have been adapted for 3D point cloud generation [4,5], it is not clear how to achieve unsupervised object detection from point cloud using GANs. Therefore, the main objective of this master project is to explore an efficient GAN architecture to detect object of interest from 3D point cloud, and employ it in agricultural fields for the detection of plants, roads and obstacles. Results aims at the representation of agricultural environment and the guidance of off-road mobile robot. The proposed trainee will take part of experiments using a 3D Lidar sensor available at INRAE.

Main activities

The main tasks of this research work are to:
1. Literature review on learning-based point cloud processing and understand Generative Adversarial Networks [2, 3].

2. Explore possible GAN structure for the detection.

3. Object point cloud gathering from simulation.

4. Validation using point cloud obtained by 3D Lidar in real agricultural fields.

Qualification and skills

Technical Skills: deep learning, computer vision, robotics

Software: Python, C++, Pytorch, ROS

Language: English

Financial support

Around 550 € per month during 6 months.

How to apply

Interested candidates should send a detailed CV, a statement of interests in the position, bachelor and Master's results, and one or more letters of recommendation to zhongkai.zhang@inrae.fr

References

1. M. Kragh, et al, Object detection and terrain classification in agricultural fields using 3D lidar data, 2015.
2. I. Goodfellow, et al, Generative Adversarial Networks, 2014.
3. Z. Zhang, et al, Surgical Tool Segmentation using Generative Adversarial Networks with Unpaired Training Data, 2021.
4. C. Li, et al, Point cloud gan, 2018.
5. D. Shu, et al, 3D Point Cloud Generative Adversarial Network Based on Tree Structured Graph Convolutions, 2019.