Enhancing Point Cloud Representation for Instance Segmentation

Laboratory: ENPC, UZH
Company: SAMP SAS
Location: ENPC, France, SAMP: Raiselab, 11eme Paris
Advisors: Loic Landrieu (ENPC ParisTech), Damien Robert (UZH), Nachwa Baker (SAMP)
Remuneration: 1200 euros gross
Starting Date: Jan-Feb 2024, 5-6 months duration
Keywords: Panoptic Segmentation, Point Cloud,
Development Environment: Linux, Python, PyTorch.

Internship Context

ENPC: MAgINE is a research group within the Ecole des Ponts ParisTech (ENPC), located near Paris. It is part of the A3SI team in the LIGM (Gaspard-Monge Computer Science lab), a collaborative lab shared between CNRS, ENPC, and Université Gustave Eiffel. IMAGINE is recognized for its significant contributions in the fields of computer vision and machine learning, particularly in 3D data analysis and deep learning.

UZH: The EcoVision Lab at University of Zurich (UZH) does research at the frontier of machine learning, computer vision, and remote sensing to solve scientific questions in the environmental sciences and geosciences. Its objective is to invent original, data-driven methods that analyse environmental data at very large scale automatically. We innovate on a very technical level and closely collaborate with our colleagues from, for example, ecology to jointly find new ways to protect our environment at global scale. Scientific projects include global mapping of vegetation parameters like canopy top height and carbon stocks at very high spatial and temporal resolution, monitoring of agricultural land, water-level prediction under flooding scenarios, or establishing a rapid-alert system that detects deforestation. On the technical side, we investigate exciting topics like uncertainty quantification in deep learning, explainable AI, graph neural networks, or time-series analysis with neural ordinary differential equations. We believe that interdisciplinary research is key to scientific breakthroughs and always aim at putting our research into practice by collaborating with NGOs, company's or public administration.

SAMP: A deep-tech French startup focused on providing as-built 3D Digital Twin Solutions for large industrial facilities. The main addressable markets include energy, water, chemical and manufacturing industries. SAMP is building a collaborative SaaS platform for remote access of 3D Digital Twins. We also focus on working with state-of-the-art 3D deep learning research to bring scale and automation to the solution. Currently the product is deployed across dozens of sites, and we are currently expanding to various countries in Europe.

Project Overview

Current point cloud processing methods often struggle with dense point clouds where distinct objects are in close proximity without clear separations. This challenge is prevalent in numerous applications, such as urban planning, industrial plant modelling, and robotics.
The primary objective of this internship is to develop a 3D deep learning model able to distinguish connected but distinct objects in complex environments, such as close cars or adjacent walls and switchboards. By addressing this challenge, the project aims to significantly improve the accuracy and efficiency of instance segmentation in real-world scenarios.

The internship will focus on researching and implementing novel 3D representations which leverage contrastive learning to improve the distinction between connected instances within a point cloud. The tasks of this internship are as follows:

1. **Literature Review**: Investigate current literature on panoptic point cloud segmentation considering both strengths and limitations.
2. **Algorithm Development**: Develop and test algorithms that can learn representations of point clouds, emphasising contrastive learning approaches.
3. **Experimentation and Analysis**: Apply developed algorithms to validate the approach on both public datasets as well as internal SAMP Dataset.
4. **Integration**: Collaborate with our team to ensure seamless integration and compatibility with other computer vision components.

**Required Profile**

- Student in Master 2 in computer science, applied mathematics or other relevant courses
- Familiarity with machine learning and computer vision concepts
- Curiosity, rigour
- (Optional) Experience with 3D data and Point Cloud, instance segmentation, and/or contrastive learning techniques

Provided satisfying results, this work will lead to the writing of a conference paper with the student and an offer of RnD Engineer position at SAMP.

**Contact**

Send a CV and a short statement of purpose (~10 lines) explaining your interest for this internship to
the following addresses: loic.landrieu@epcn.fr, damien.robert@ign.fr, and nachwa@samp.ai

References

