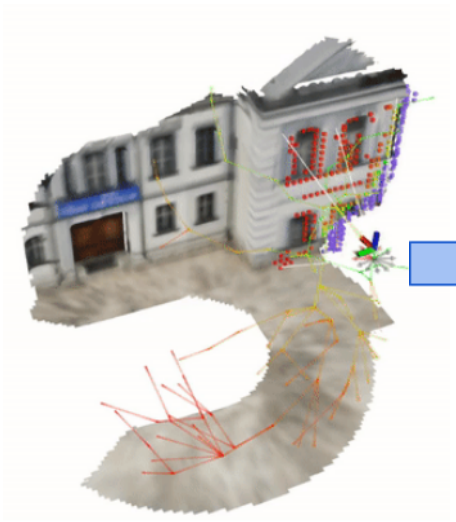
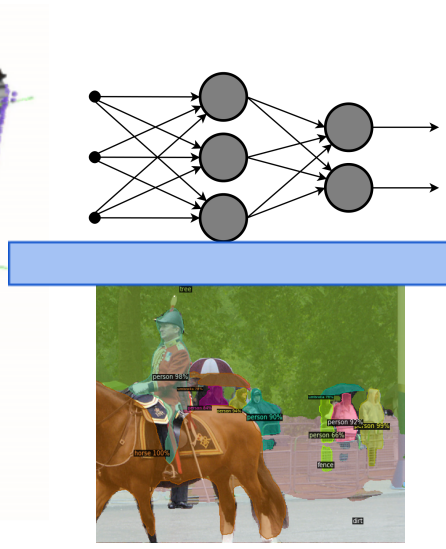
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Active Path Planning for Accurate Panoptic Segmentation

Semester Project / Master Thesis





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Description

A central capability for autonomous robots to act intelligently is to build a higher level understanding of their surroundings. In the panoptic setting, this means identifying individual object instances as well as semantic classes of the background. Traditionally, this is achieved through fusing multiple semantic predictions, typically obtained from a Convolutional Neural Network (CNN) into a dense map of the environment.

However, a major difference between many computer vision applications and robotics is that a robot has the ability to actively move in the environment, thus not only affecting how the perceived data is segmented but also what data is collected.

In this project, the goal is to develop an active path planning algorithm that let's a robot decide where to take measurements during online mapping, in order to discover the full environment and detect and segment all objects in it. This includes primarily the integration of an approach to quantify panoptic uncertainty in a dense map, design of an information gain and path planning approach that leverages panoptic segmentations of the environment, and development of metrics to assess panoptic quality of a map. Infrastructure for photo-realistic simulation, volumetric panoptic mapping, and modular exploration path planning is provided. In case of project success, the student is invited to contribute towards a publication of the work.

Work packages

- Literature Review.
- Development of a panoptic map quality metric and estimator.
- Development of an active path planning approach for panoptic segmentation.
- Evaluation of the proposed system.

Requirements

- Highly motivated and independent student.
- Strong interest in Robotics and Computer Vision.
- Programming skills in C++/Python are mandatory.
- Experience with ROS, Git, Unreal Engine 4, Pytorch/Tensorflow/Caffe, and other frameworks are a plus.