Stephen Kyberd (Oxford Robotics Group) – Autonomous Vehicles as a case study

Abstract

The Oxford Robotics Institute's (ORI) work addresses the challenge of performing efficient model-based object detection in 3D point clouds by using a neural network based approach which specifically exploits the sparsity inherent in 3D data. Much of the ORI's localization, perception and 'mapping' work uses laser sensors to create dense 3D point clouds. This stream of 3D point cloud data is fed into a system of algorithms to observe parts of the environment according to their similarity and refines that grouping as new data is observed and enforces geometric consistency by probabilistically reasoning on cluster memberships of parts that are physically close to each other.

At the same time, the ORI is exploring further data that may be obtained to help the City Council and its partners to better manage the city. Among others, the data being trialled as part of the project will include road and pavement surface damage, air quality, and people numbers and movement.

- When looking into autonomous vehicles, three essential questions need to be addressed:
    - Where am I?
    - What is around me?
    - What do I do next?
- This presentation focuses on the *Where?* and *What?*
- Autonomous vehicles are anywhere between 5 and 50 years away from now
- Much of the technology that exists today is useful
- The ORI don't use GPS to build maps because it drifts around (the detail provided by GPS is not good enough)
- use both cameras and lasers in their 'mapping' work
- Use 3D point clouds from laser sensors to build 'maps'

Where?

- Have created colourful point clouds in Milton Keynes (UK)
    - The vehicles have been equipped with a wide range of sensors, including stereo cameras, LIDAR (laser-scanners) and radar-based obstacle detectors – as well as the computers required to process the incoming information and steer the vehicles
        - use information from the sensors to work out where they are within a pre-mapped environment

What?

- Situational awareness is crucial for safe operation in real-world, dynamic environments

- The ORI examine how to equip machines with a semantic understanding of the world - how can reliably recognise objects of interest across vast seasonal and environmental changes
    - Use an approach to segment objects of interest from a raw data stream as obtained from a 3D laser range finder
    - focus on the extraction of potentially dynamic objects such as cars, pedestrians and bicyclists

Local Authority efficiency project

- Also work with Oxford City Council to transform how it manage its services across the city
    - sensors attached to a City Council street cleaner in the city centre to create point clouds that can be used to trial the development of autonomous vehicles
    - the ORI is exploring further data that may be obtained to help the City Council and its partners to better manage the city. The data being trialled as part of the project will include road and pavement surface damage, air quality, people numbers and movement, litter and fly-tipping, parked vehicles, broken streetlights and signs, and heat loss from buildings

Q&A

We have not seen any maps. These are point clouds. There is no classification of objects.

- It provides additional information
- It is not a 'human' map, but it tells the computer where it is

Are the data sets that are produced free to use?

- The data sets are openly available
- The processing of the data is currently not freely available
- *Why not?*
- It takes time and effort and the ORI is currently not focusing on that
- When we have something that can be used by itself as a project, then the ORI makes it available

AS others have pointed out, what you have shown are point clouds. Would it be more effective to use a standard map?

- Cameras are cheaper

In Nigeria, we use point clouds for asset management, but these are no maps. However, for asset management they are brilliant.