University of Cape Town

EEE4022S - Final Year Project

Spacial and Temporal Calibration of Multi-Sensor Systems

Michael Katsoulis

KTSMIC005

24 June 2020

Plagerism Declaration

1. I know that plagiarism is wrong. Plagiarism is to use another's work and pretend that it is one's own.
2. I have used the IEEE convention for citation and referencing. Each contribution to, and quotation in, this final year project report from the work(s) of other people, has been attributed and has been cited and referenced.
3. This project report is my own work.
4. I have not allowed, and will not allow, anyone to copy my work with the intention of passing it off as their own work or part thereof.

Michael Katsoulis
22 June 2020

Contents

1 Introduction

Why we want to calibrate a system In the modern world, the need for autonomous vehicles is growing daily. They would improve the quality of human life, provide advances in science and open new opportunities. One of the problems that is being faced at the moment is that vehicles are of different shapes and sizes, this leads to the sensors on each vehicle being in different locations.

The goal of this project is to investigate the current methods of determining the spacial as well as temporal offsets between sensors on a vehicle automatically. This would allow a decrease in calibration time, ease of manufacture as well as allow vehicles to continue to operate in the case of an unforeseen incident moving a sensor. This would allow for cheaper and more robust vehicles.

Same algorithm on multiple models of vehicle.

Drones which can reconfigure in flight or continue if damaged.

Configurable vehicles which adapt to their modification.

1.1 Research goal

1.2 Literature Review

How do we get each form of error Spacial –> straight forward Temporal –> filters, length of communication, different clocks in sensors.

Attempts to fix temporal error - clock synchronisation - sensor reading time stamping etc.

From the literature that has been reviewed, there are two main categories of calibration methods. The first uses markers that are of known shape, texture and size by design which are placed into the environment and used for calibration. This is a more hands-on, involved approach but it is often simpler. The other method is markerless calibration. In these cases, the goal is to use the information in the natural environment around the vehicle in order to calibrate the sensors. This often involves removing targets which are moving relative to the global frame and trying to isolate those which are static.

The most common sensors used in autonomous vehicles are lidar and stereo cameras. On the fly Camera & LiDAR Calibration TODO ref The main task is to find an efficient way to map point clouds from lidar sensors to the pixels of camera sensors. In TODO ref the solution to this problem was to have two sets of calibration, one rough and the other small detail fine alignment. To do the coarse alignment, they expanded the point dots into planes and tried to find objects in both the lidar and camera images using straight lines.

– CNNs for finding these objects?

Change this so it's an include

Put the rest as another file