Summary: Exploring the use-case for low-cost solid state LiDAR in automotive safety

James O'Donohoe

October 2024

Abstract

When one thinks of Lidar in an automotive context, they assume it will be for the purpose of autonomous driving. There are examples of such projects using cutting edge 360 degree, single photon lidar systems that cost more than most cars, and are still held back by the software and computational power they require. A lower cost solid state system stands a better chance of making it to the mass market and improving road safety for all. This thesis investigates the use of such systems, characterises their performance, and investigates how their data can be used more effectively.

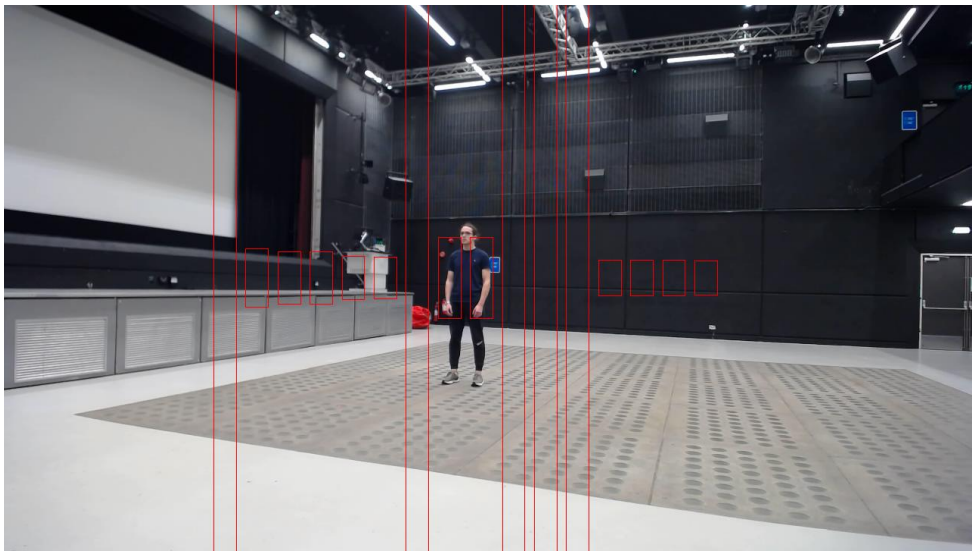

Figure 1: Overlay image of data collection

Thesis Outline

The aim of this Thesis has been to explore the potential for LiDAR to improve road safety for all. Overall the accuracy of the detectors when seeing a person was about $9cm$, which is higher than the stated accuracy from the manufacturer, but is perfectly reasonable when determining if a pedestrian is in front of a vehicle or not.

However, the invisibility of a low reflectivity object in front of a white wall does raise a substantial safety concern, if an object can go entirely unnoticed on a bright background there is potential for serious accidents.

As part of the project attempts were made to detect features using the sensors. While this worked for small sections of walls, it was inconsistent due to the limited amount of data-points provided by such a setup. To effectively locate a vehicle within a known 3D map of the environment would require a setup with far greater resolution.

Throughout these experiments, the range that has been tested has all been under $15m$. Using the two second rule of thumb for following distance this would give a maximum safe speed of $\approx 17mph$. However, not accounting for the one second thinking time factored in for a human driver it could feasible be stretched to $30mph$.

This positions LiDAR as a feasible safety tool for cars in city driving when considering pedestrians, and on motorways when considering other moving, but slowing cars, removing human reaction time from the equation.

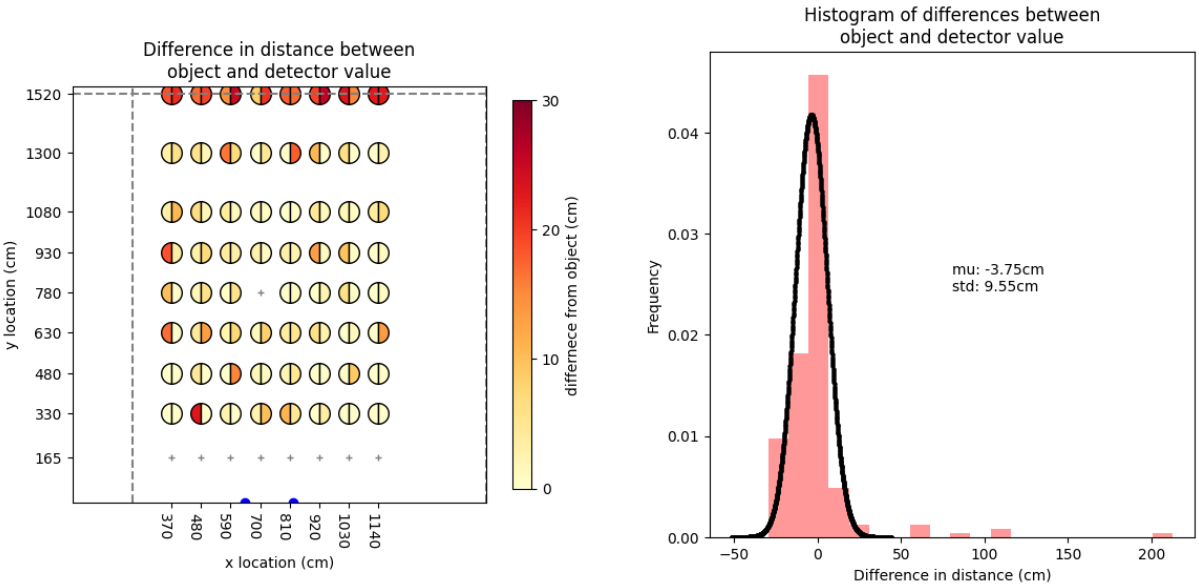

Figure 2: Example of experimental results