5 Conclusion

References

* usa a abreviatura das conferências

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Sugestão: usa o et al. se forem mais de 2 autores. Utiliza o nome das conferências abreviado, ou mesmo só o acrónimo, evita colocar o DOI e URL se for possível chegar à referência sem esses dados

⇓

claro que tudo isto depende do facto de haver ou não um template, mas se o template for retirado/adaptado do template de um jornal, normalmente ñ há problema de se simplificar na bibliografia

Comentários gerais:

1) No início apresentas o ADAS de forma negativa.
sugestão:
a) situação atual é má → acidentes
b) ADAS promissor, mas ainda embrionário
c) tem-se vindo a trabalhar muito no ADAS
d) LiDAR como um dos sensores mais relevantes.

2) Provavelmente reduziria ou retiraria a equação do TOF (ex. quando falava no LiDAR neste ponto colocava uma boa referência que o leitor possa consultar se achar adequado). e explicava um pouco melhor a parte de interferência → o que é, de onde vai, ao que é que se traduz e o que pode levar em termos de condução autónoma ⇒ Assim dás um maior ênfase e relevância do problema a tratar.

3) Para mim a secção related work é desnecessária e podia ser colocada diretamente na introdução. Aqui também, numa curta frase, sumariava o trabalho do Kim et al. o que fez e o que concluiu, ~~...~~ que é o que não foi referido aqui

4) O capítulo 3 está OK. Fica um pouco difícil ao leitor perceber de imediato o porquê de teres feito aquele setup em específico, mas uma explicação mais detalhada seria para um artigo mais extenso.

5) Como referi, no capítulo 4 não faria subsecções e seria mais algo do género: resultado → análise, resultado → análise
⋮
análise/discussão holística e global

(1) não de acordo com a Tesla que diz que não precisa de LiDAR. Aqui mudava para o conjunto de sensores é necessário porque todos eles aumentam redundância, logo menos impacto se um dos sensores falhar, diferentes sensores têm diferentes vantagens e que o LiDAR é um dos mais importantes.

Multiple Interference on Time-Of-Flight 3D LiDAR

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Abstract

→ dá uma visão muito pessimista do ADAS. Transmite a ideia que o ADAS não traz vantagem nenhuma e, portanto, não vale a pena investir esforço e dinheiro

1 Introduction

Since the appearance of Advanced driver-assistance systems (ADAS), consumers, experts and governments hoped that "smarter" cars would result in safer roads. Despite remarkable advances in ADAS technology, safety awareness campaigns, annual global road traffic deaths have reached 1.35 million, being the leading cause of death for people aged 5-29 years [11].

Several studies have been conducted on self-driving cars [1, 2, 8] and some public datasets have been made available to further the development of self-driving algorithms and data analysis methods [3].

Despite all the research on this area, most of the current state-of-the-art (4) for autonomous driving relies heavily on Light Detection And Ranging (LiDAR) - a device capable of measuring the depth from a scene by using light beams. The most common LiDAR sensor is a Time of Fligt (TOF) LiDAR, which acquires depth information by measuring the time elapsed between the emission and reception of the same light pulse. The distance ~~of~~ to the reflective object, *d*, can then be obtained (in a simplified view) through equation (1), where *c* is the speed of light in meters per second and Δt the time between the emission and reading the laser pulse, in seconds.

$$\boxed{d \approx \frac{c \times \Delta t}{2}} \quad (1)$$

a luz propaga-se do LiDAR para o objecto e do objeto de volta para o LiDAR

However, despite the ~~overall adoption~~ of such sensors, there are no guarantees that the pulse received by the emitter & receptor pair correspond to the emitted pulse, therefore causing a wrong measurement. This can happen in two scenarios:

1. Noise;
2. Interference.

This paper focus on a specific case of the latter scenario: multiple mutual LiDAR interference, i.e., when two or more LiDAR are present in the same space and cause interference on each others measure.

This paper is organized as follows. Section one presents the introduction to this work. Section two debates the related work. The third section shows the experimental results obtained, while the setup and the last section, Results. Section five deliberates on the paper's conclusions.

↳ não percebi. Refrasear.

2 Related Work

Despite the relevance of the topic for the massification of self-driving vehicles and the hazardous impact on ADAS reliability, the research topic presented in this paper has received very reduced attention by the research community. To the best of the author's knowledge, there are only available the studies conducted by Kim *et al.* [4, 5, 6, 7] (2), which seek to characterize this interference; and by Retterath and Laumeyer[9], seeking to provide an apparatus for reducing the mutual interference of LiDAR sensors on the same vehicle.

A major LiDAR manufacture [?] also addresses the problem of mutual interference of the LiDAR sensors on the same vehicle, by allowing their synchronization and laser firing in different instants [10]. → podes dizer Velodyne :)

Kim *et al.* research, despite using a 2D LiDAR instead of a 3D LiDAR (more commonly used for self-driving vehicles), is the only study

Podes fazer de forma condensada [4-7]

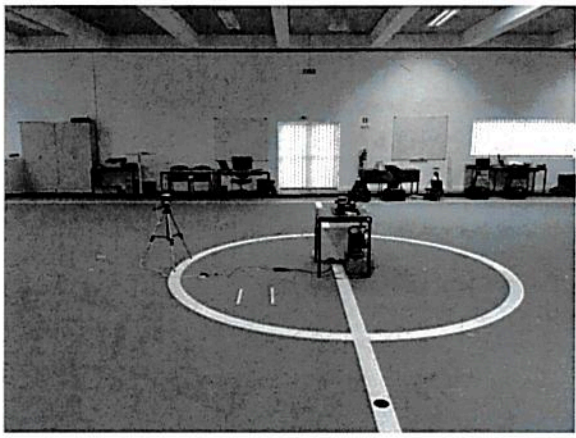

Figure 1: Example of one of the experimental setup apparatus. On the table there is a VLP-16 LiDAR, that acts as the source and on the tripod the movable LiDAR, that acts as the interference generator

→ podes referir Hesai

to consider the two independent LiDAR interfering with each other on which? ~~each the~~ user has no control over the interferer, as ~~has~~ would happen if the two LiDARs belonged to two different vehicles.

3 Experimental Setup

Podes referir o Hesai. Atualmente já está disponível para adquirir

To study multiple LiDAR Interference, two LiDARs where used. The source LiDAR (from where the data was acquired) is a Velodyne VLP-16, containing 16 laser beams and the interferer LiDAR is a 40 laser LiDAR. The former is fixed on a table and acts as the source LiDAR, from which data is received and the latter acts as the interference generator that is fixed on a tripod, allowing its re-positioning to create more tests.

Several tests were performed, varying the distance between both LiDARs, height, direction and by blocking direct interference.

The software has been developed in C++ using the Robotic Operative System (ROS) framework with custom Point Cloud Library (PCL) code for data analysis and near real-time operation on a standard laptop computer.

4 Results

Results are not complying between change detection and point to point analysis

4.1 Ground Truth Generation

Voxelization + ICP
Should be here? It's different for point by point or voxel analysis

4.2 Interference Analysis

Octree Change Detection + Voxelization
Should be here? It's different for point by point or voxel analysis

4.3 Results

Table/Histogram with choosen method

→ não faria sub-secções, em artigos de conferência tão curtos eu apresentaria gráfico → discussão, gráfico → discussão e um parágrafo final (se fizer sentido) de análise de resultados mais geral)