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I want to write about the limitations that current SLAM models have and how these limitations can be removed through improvements by correct use of hardware. I would also like to propose my own ideas while also talking about what has already been done. I want to share how I would approach some of the problems in this area. I hope to cover some of my ideas in some limitations revolving around these specific parts shared on the survey: “3.3.1 Dynamic environments”, “3.3.2 Semistatic environments“, “3.3.3 Deformable environments”.

3.3.1 Dynamic environments

Initial versions of SLAM assumed that the world is static and yet the advancements on the past 5-10 years in hardware allowed computationally heavy models to be used for object detection so that estimation of the velocity of pedestrians and cars passing by can be done. The earliest methods, which assumed that the world is static, to me are just very hard to even believe as accelerometers could have been utilized to filter the data and understand if the car itself or the other moving objects in the scene were causing the change in the scene. It is interesting to me when I have read “Did I move or did the world move?” on page 16 as I thought that this is the ground level zero problem which should have been solved even before people decided to use stereo cameras combining multiple images and using smart techniques to understand depth. I think that doing velocity estimation based on object classification is the solution to this as mentioned by many of the papers mentioned on page 17 under Dynamic environments.

3.3.2 Semistatic environments

There are multiple papers mentioned on page 17 under Semistatic environments. Most of these methods are effective in solving the problems caused by maps that change over time. My personal approach to this problem would be by making use of Batch Active Learning or just regular Active Learning. Imagine having the same problem at Tesla and having a fleet of cars constantly scanning the roads transmitting data back to where they work on the main full self-driving model. The data is completely unlabeled so it is a huge challenge to label all of this data including the changes that occur on the maps. I would consider each car as a “worker” or a “student” as referred in different resources. The “teacher” or the “expert” model would be the imaginary full self-driving model that gets constantly trained at the Tesla Headquarters. The students would make estimations of what is happening at that point and once there are enough estimations and confidence in a certain label the teacher would learn from that and it would update every agent. This way a fleet of cars would not only keep an updated map of everything but also they would know how to react once they suddenly fall into a map, which they did not expect.

3.3.3 Deformable environments

Deformable environments are places where there are deformable objects and the agent is traveling through these deformable objects. This clearly is a time series problem where there are 3D points in space and these 3D points are changing places relative and relatedly to one another at a certain rate. This paper, which also is cited on the survey, is a great paper “An observable time series based SLAM algorithm for deforming environment” which explains the reason why this is a time series problem. The paper uses strategies used in biomedicine related datasets in order to solve the deformable SLAM environment problem. The mapper makes it evident that standard rigid SLAM formulations are outperformed with their proposed method. Overall, there is great parallel in mapping other deformable areas such as the interior of a human heart and other deformable areas so the problem is much larger than the scope of autonomous driving.