

SLAM in a Dynamic Large Outdoor Environment using a Laser Scanner

Huijing Zhao*, Masaki Chiba**, Ryosuke Shibasaki***, Xiaowei Shao***, Jinshi Cui*, Hongbin Zha*

Introduction

Our final goal is to enhance driver safety in a **dynamic and unstructured large** environment, where the intelligent vehicle might be close to other moving objects, so that high accuracy is required for understanding the situation of each object. We want to **detect the moving objects** in the surroundings, and **track their states**, such as speed, direction, and size, so that dangerous situations can be predicted. We also want to **generate a map** of global accuracy, and locate our vehicle on it.

This is a particularly challenging topic!

Algorithm

Probabilistic Formulation

$$p(x_k, y_k, s_k, m | z_{0:k}, u_{0:k}) =$$

$$p(s_k | x_k, m, z_{0:k}^{(s)}) \times$$

$$p(y_k | x_k, m, z_{0:k}^{(y)}) \times$$

$$p(x_k, m | z_{0:k}^{(m)+(s)}, u_{0:k})$$

Tracking problems

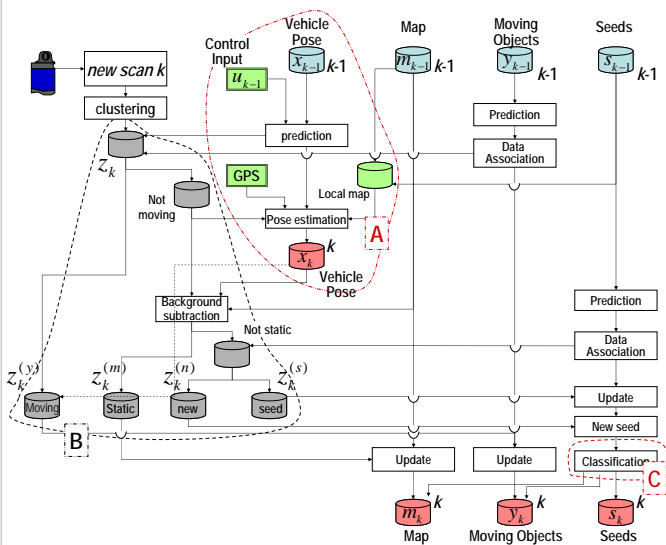
A SLAM problem

Where,

$$z_k = \{z_k^{(m)}, z_k^{(y)}, z_k^{(s)}, z_k^{(n)}\}$$

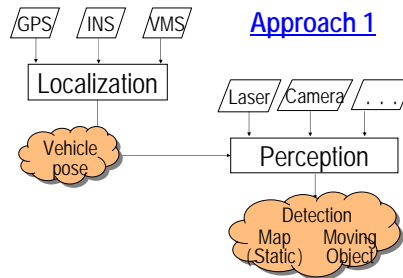
How to classify the clusters?

How to classify the objects into mobile and static objects?



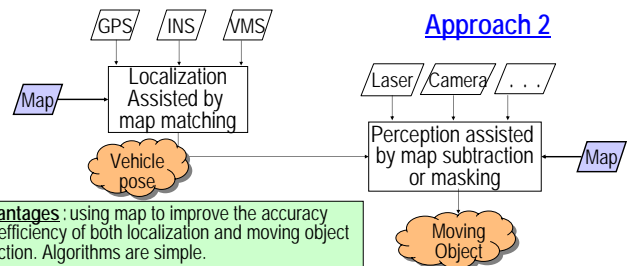
- A** SLAM based pose estimation with GPS guided trajectory-oriented loop closure
- B** Classification of the observation data (the clusters of current scan)
- C** Classification of the seed objects (the objects of either mobile or static object)

Approaches



Advantage: vehicle's pose estimation and environmental perception are conducted by individual modules. Algorithms are straight forward and mature.

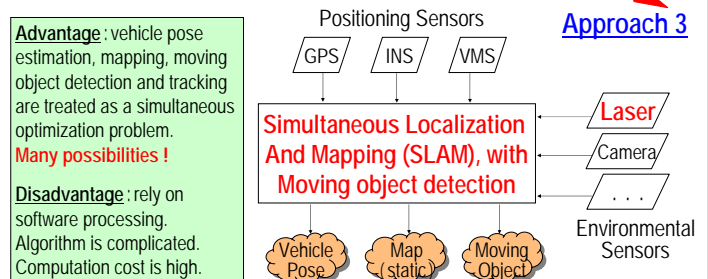
Disadvantage: the accuracy of vehicle's pose estimation is heavily dependant on positioning sensors. Difficult to detect slow motion objects, such as people, due to pose error.



Advantages: using map to improve the accuracy and efficiency of both localization and moving object detection. Algorithms are simple.

Disadvantage: need a reliable map, which is a strong limit to applications.

Our try!



Advantage: vehicle pose estimation, mapping, moving object detection and tracking are treated as a simultaneous optimization problem. Many possibilities!

Disadvantage: rely on software processing. Algorithm is complicated. Computation cost is high.

Experimental Results

