Gaussian Process Labeled multi-Bernoulli Filter for Tracking in Dynamic Environments

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In autonomous vehicles an important task is to interpret the surrounding world through various sensors. A range sensor used in many applications is the Lidar. It provides range measurements and was in this project used to measure the contour of vehicles. By implementing a Gaussian Process Labeled multi-Bernoulli filter multiple vehicle states were estimated from the contour measurements in a Bayesian framework. The state was in this case

Figure 1 – Webots scenario with 2 cars in roundabout and static objects.

the position, heading, linear and angular speed together with the vehicle extent, as a star convex shape, where the shape was learned with a recursive Gaussian Process. Furthermore, labeled tracks for each target were propagated so that the trajectory could be obtained. Tests were carried out in Webots (see figure 1) and

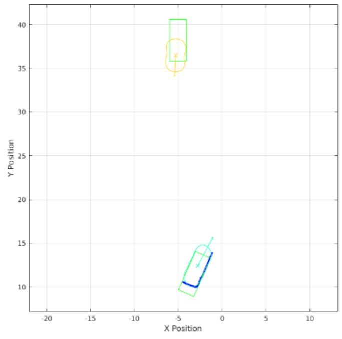

Figure 2 – Two vehicle state estimates, where the top one is occluded. Blue dots are measurements, green rectangle true position and yellow/blue are estimates.

with real data and showed to estimate the vehicle states. By implementing an occlusion model for the vehicles it was possible to keep targets alive that could not be seen in several time instances.

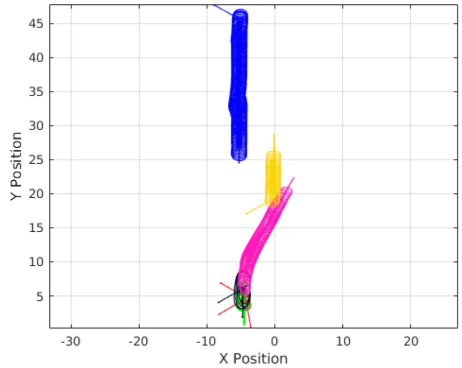

Figure 3 – Target tracks are shown with different colors. The blue track was occluded for several time instances.

This created a better cardinality estimate and track representation. In figure 2 a scenario where one car was occluded and then became visible again, is shown. The tracks for this scenario are as in figure 3 and it can be seen that the target was tracked even though it was occluded. Having created the tracking filter an approach to extract measurements generated from moving objects in a world scenario, was created. An Occupancy map was created from a Simultaneous Localization And Mapping approach and dynamic measurements was filtered out by clustering measurements and checking if they belonged to occupied cells or not. To correct the vehicle position in the map, landmarks were extracted by use of a Maximal Stable Extremal Regions algorithm and tracked to estimate the position of

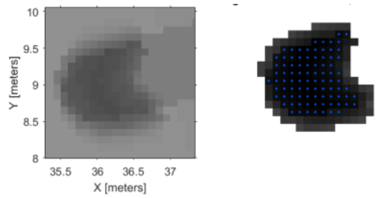

Figure 4 – Landmark region extraction with MSER.

the vehicle. An example of a map is shown in figure 5.

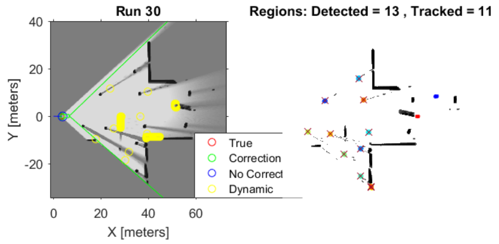

Figure 5 - Left :Occupancy Grid map with dynamic measurements as yellow circles. Right: Landmarks identified as colored regions and crosses indicate regions used for correction.

By use of the SLAM and dynamic data extraction approach it was possible to track and estimate vehicle states in a world scenario with static objects.