Radar Odometry

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A fundamental problem in autonomous vehicle operation is localization and navigation. An AV is expected to achieve robust operation in a dynamic environment. Vision and LiDAR based methods have been treated widely, but are susceptible to lighting changes and bad weather. RADAR is a sensing modality that is recently becoming more viable to deploy on vehicles. Unlike LiDAR, RADAR comprises of signals of larger wavelength, and therefore, is more resilient to aforementioned effects which are detrimental to LiDAR and Vision based systems. Thus, there has been recent interest in ego-motion estimation (odometry) using RADAR data. However, due to the noisy nature of radar point clouds, this problem is challenging to solve [1, 5].

Broadly, there are two steps to RADAR-based odometry. The first step is to process the point cloud, remove noise or ghosting to extract important features or landmarks that provide the basis for self-tracking. This could be done by converting the radar into images and extracting features. There are some filtering-based algorithms like CFAR which are designed specifically for radar sensor outputs. The next step is to perform data association on these landmarks to map them to the same object observed at different times. Such association could be done by fusing data from other on-board sensors or through some kind of scan matching using the radar data itself.

Goals: In our project, we propose to (using the RobotCar dataset [2]):

1. Study DBSCAN and CFAR as landmark extraction techniques [3].
2. Explore the Iterative Closest Point (ICP) and Lidar sensor fusion as scan matching candidates [4]
3. Choose techniques at each stage and build a full system. Compare with state-of-art [1]

Proposed Timeline:

1. Week 7: Literature survey, study algorithms, and identify benchmarks.
2. Week 8: Simulations of individual functions, obtain metrics.
3. Week 9-10: Implement end-to-end system, and compare metrics with state-of-art.

References

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[4] E. Ward and J. Folkesson, "Vehicle localization with low cost radar sensors", Intelligent Vehicles (IV) Symposium 2016 IEEE, pp. 864-870, 2016.

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