Autonomous Vehicle LAB - ICP

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***Abstract*—The objective of this lab is to get hands on experience with real driving data-set from NuScenes and try out ICP algorithm for localization and occupancy grid is created from real driving data. On top of that, occupancy grid is created using LiDAR scan.**

I. Introduction - ICP

Alignment of 3D shapes has been used in several applications such as object recognition, building models for virtual reality, align multiple scan results and combine them for a whole object etc. In point to point correspondence, two dataset forms correspondence pairs and minimize the point to point error using squared distance between points iteratively. Another method is to use point to plane error and optimize the sum of squared distance between a point and tangent plane at correspondence point. However point to plane algorithm has slower iteration rate than point to point but shows promising convergence rate.

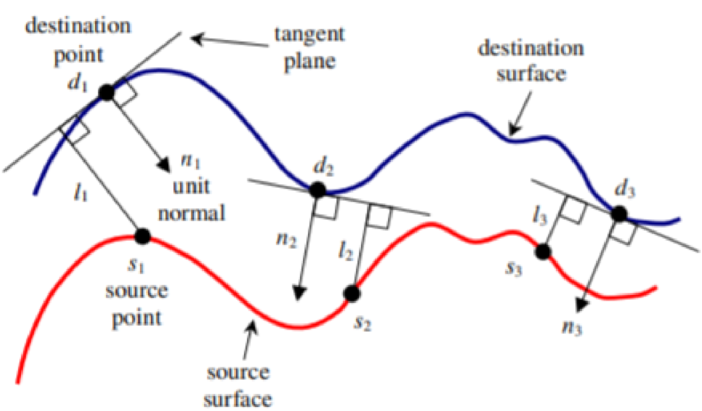

Fig. 1. Point to Plane correspondence

II. Work

During this lab small data-set of driving at different scenarios from Asia-pacific region has been analysed from NuScense. nuscenes-devkit has been used to process the data. Database structure can be found here.

To get visual odometry using LiDAR point cloud and ICP algorithm, implementation from open3d has been used. It calculates the homogeneous transformation matrix between source and target using both cloud.

With the data of LiDAR scan data, vehicle pose and log-odds an occupancy grid is created for the given movement. It is carried out using Bresenham algorithm

III. Analysis

Two different instance has been observed for this section. Vehicle turning to left and vehicle stopped on signal. Results from vehicle turning left are shown in Figure(2 to 4) (Index-0 from data). Result from vehicle stopped on signal are shown in Figure(5 to 7) (Index-2 from data).

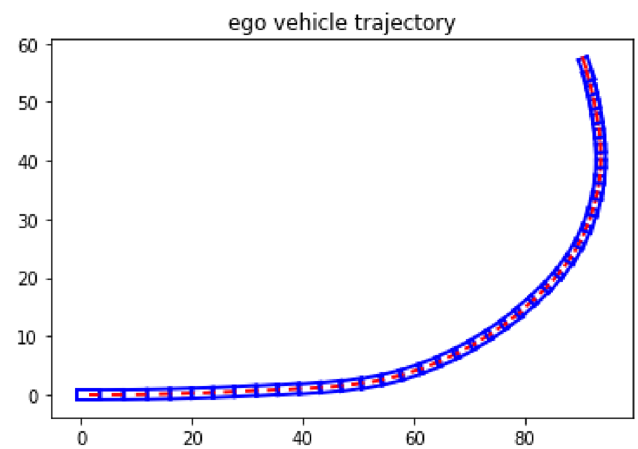

Fig. 2. Trajectory - Left turn

IV. Conclusion

It is observed that while vehicle is not moving, visual odometry does not gives the satisfactory results. Even while vehicle is steady , near by surrounding is changing constantly due to the pedestrians passing. That triggers camera system to suggest the vehicle moving even if its not. And this leads to the error in the trajectory. Here it is important to merge visual odometry with the actual odometry or with the output of CAN-bus to get the information of actual velocity of the vehicle.

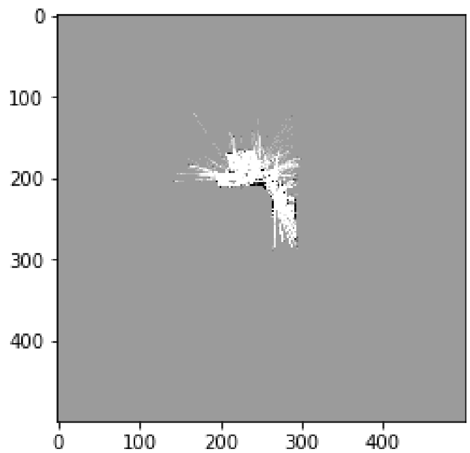

Fig. 3. Grid map - Left turn

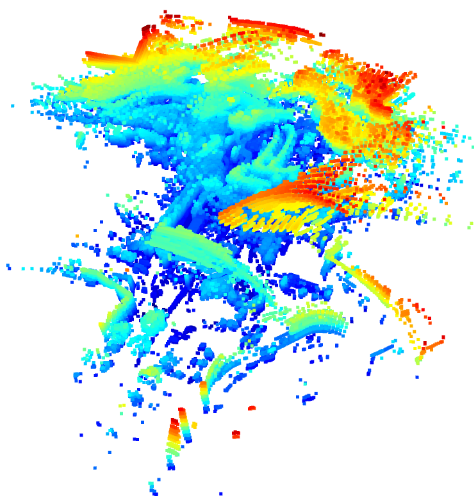

Fig. 4. Point cloud - Left turn

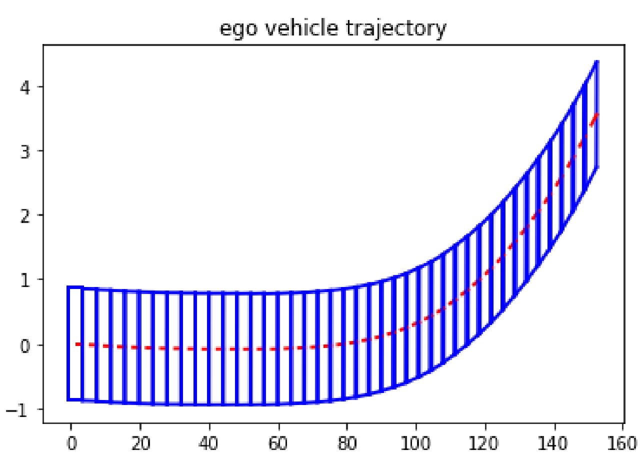

Fig. 5. Trajectory - Stopped

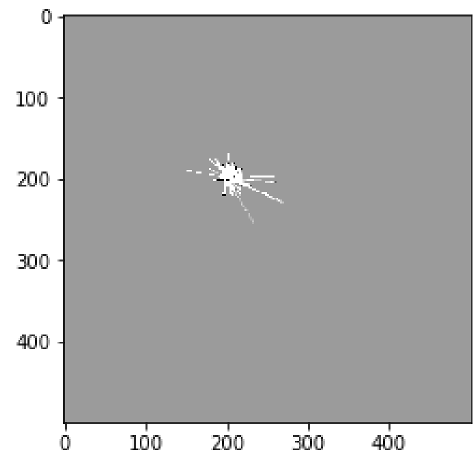

Fig. 6. Grid map - Stopped

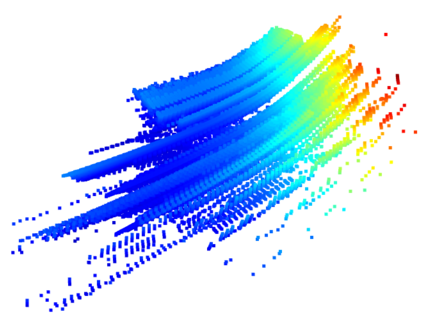

Fig. 7. Point cloud - Stopped