The Problem

- Segmentation algorithms may not always provide exact division between planar surfaces, especially in outdoor street view images.
- Street view images are prone to a lot of occlusion, hence, estimating the ground - vertical planar intersections, by simply visualizing segmented data in 2D is not a feasible solution.

The Objective

- To design an algorithm which can detect ground – vertical planar intersections in street view images.
- The algorithm should be robust to occlusions in the scenes under consideration and should make boundary estimations accurately.

Resulting Outcomes

- Estimating intersections between ground and vertical planes efficiently allows for accurate 3D reconstruction of scenes involving outdoor environments
- The estimation of planar boundaries can be used for developing better navigational algorithms for autonomous vehicles
- The algorithm provides a methodology which is occlusion invariant to a large extent. The requirement however is that at least some points belonging to the intersection should be visible to the framework.

Overall Framework

<table>
<thead>
<tr>
<th>VELODYNE LASER SCANNER</th>
<th>CAMERA CALIBRATION DATA</th>
<th>IMAGE FRAMES FROM CAMERA</th>
<th>3D GROUND PLANE ESTIMATION</th>
<th>LABELLING</th>
<th>ALGORITHM</th>
<th>ESTIMATION OF PLANAR SURFACE INTERSECTIONS</th>
</tr>
</thead>
</table>

Overview of the Algorithm

**STEP 1.** Input Image and Labeled data to Algorithm

**STEP 2.** Estimate Equation of Ground Plane in 3D using Camera Calibration data and 3D Velodyne points

**STEP 3.** Attain binary mask from labeled data and find 2D points which might form parts of the ground - vertical planar intersections

**STEP 4.** Back-Project the 2D coordinates onto the 3D ground plane

**STEP 5.** Remove Projections having Negative Depths, i.e., projections behind the camera, followed by RANSAC to find the equation of ground-vertical intersection in 3D

**STEP 6.** Attain Equation of the Vertical plane, perpendicular to the Ground plane and passing through the line fit by RANSAC.

**STEP 7.** Back-project the 2D coordinates again onto the attained Vertical plane

**STEP 8.** Remove Negative Projections followed by Maxima and Minima Depth Estimation

**STEP 9.** Perform 3D to 2D Mapping

Results

3D Skeletons from Single View

Conclusions and Future Work

- A robust methodology to estimate planar intersections in street view images has been designed
- The algorithm works well even in cases of vehicles, people etc occluding the actual intersections.
- Incorporating the algorithm with 3D reconstruction algorithms could form part of future work

References


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