Estimating Planar Intersections in Single Street View Images

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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.

Segmentation in street images

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.

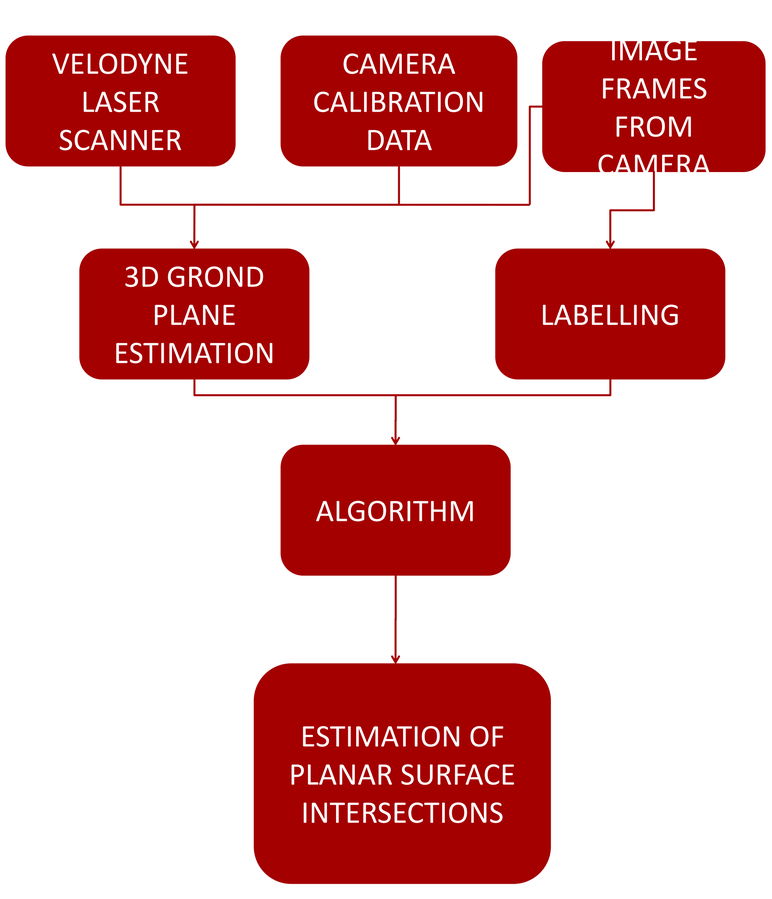
Resulting Outcomes

• 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 atleast some points belonging to the intersection should be visible to the framework.

Overall Framework

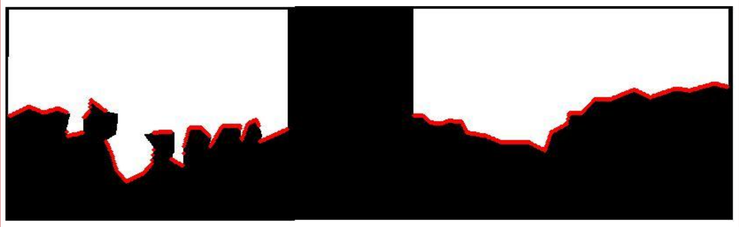


Overview of the Algorithm

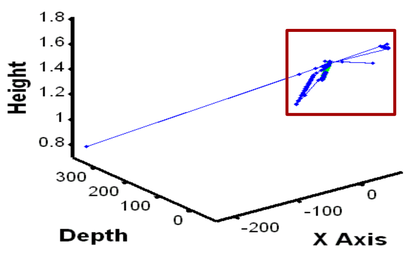
STEP 1. Input Image and Labeled data to Algorithm

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

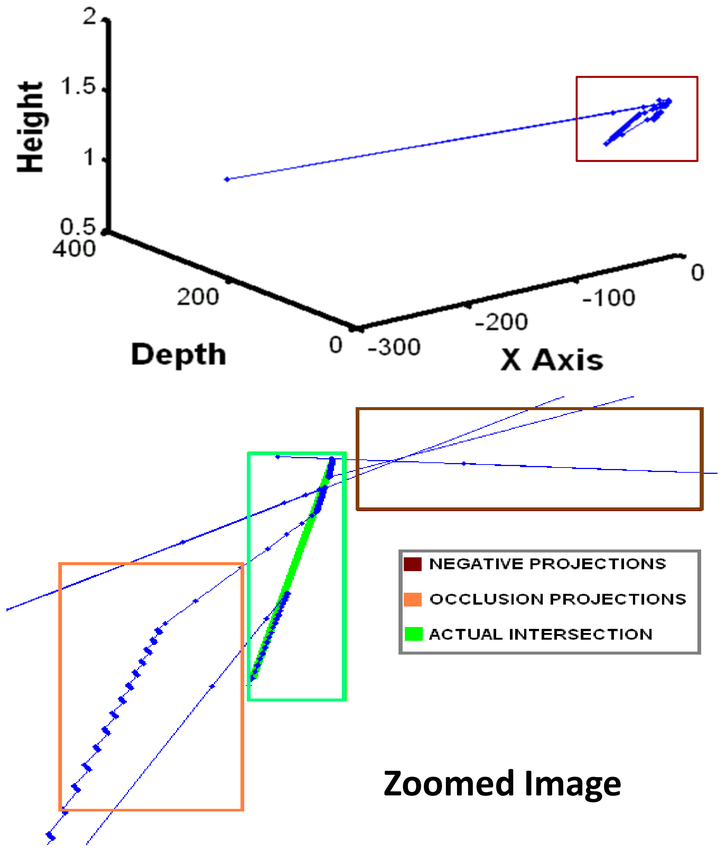
STEP 3. Attain binary mask from labeled data and find 2D points which might form parts of the ground - vertical planar intersections



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



Zoomed Image

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

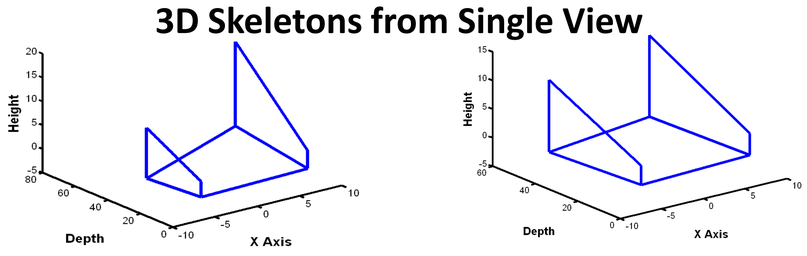
STEP 7. Back-project the 2D coordinates again onto the attained Vertical plane

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

1. D. Hoiem, A.A. Efros, and M. Hebert, "Automatic Photo Pop-up", ACM SIGGRAPH 2005
2. D. Munoz, J. A. Bagnell, M. Hebert, Stacked Hierarchical Labeling, European Conference on Computer Vision (ECCV), 2010

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