# ASPPR: Active Single-image Piecewise Planar 3D Reconstruction Based on Geometric Priors

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## Appendix A   Dataset

During the experiments, three datasets of buildings in which planar structures dominate were employed for the evaluation, the details of which are as follows:

(1) LUND dataset [1]: Alcatraz courtyard (AC, 1936×1296 image resolution) and UWO (1936×1296 image resolution).

(2) CASIA dataset [2]: Tsinghua school (TS, 4368×2912 image resolution) and life science building (LSB, 4368×2912 image resolution).

(3) Our dataset: City building (CITY, 1224×1848 image resolution).

For each dataset, 100 images are randomly selected for evaluating the quality of the piecewise planar building reconstruction. Moreover, for each image, the polygonal region corresponding to each plane is manually annotated to produce the ground truth data (including polygonal regions and planes) where each plane is produced by fitting the 3D points which are only projected into the annotated polygonal region. In this regard, the 3D points are generated only for the CITY dataset using the COLMAP method [3]. The other two datasets already have with 3D information.

## Appendix B   Metric

The following five criteria are used to evaluate the accuracy of the reconstructed planes.

(1) Number of reliable planar regions (NR): For a reconstructed plane, the corresponding image region (i.e., planar region) is considered reliable when the IOU (Intersection over Union) value with respect to the ground-truth planar region is larger than the pre-specified 0.5.

(2) Number of reliably reconstructed planes (NP): A reconstructed plane is considered reliable when the corresponding mean of the differences in plane parameters proposed in [4] is smaller than the pre-specified 0.6.

(3) Average accuracy of planar regions (AR): The average value of all NR/GTR (where GTR denotes the number of ground truth planar regions) values corresponding to all images.

(4) Average accuracy of reconstructed planes (AP): The average of all NP/GTP (where GTP denotes the number of ground truth planes) values corresponding to all images.

(5) Number of interactive plane modifications (NI): The number of interactions (i.e., IPM-1, IPM-2, and IPM-3) used in interactive plane modification. For the same results, the smaller the NI value, the more reliable interactive plane modification is for automatic plane optimization.

Table 1.  Quantitative results

| Dataset | IRP(NR) | API(NP) | ASPPR | | ASPPR-I | | GT |
|---|---|---|---|---|---|---|---|
| | | | IPM(NI) | APO(NP) | IPM(NI) | NP | |
| TS | 4 | 4 | 0 | 4 | 9 | 4 | 4 |
| LSB | 8 | 4 | 2 | 7 | 17 | 8 | 8 |
| AC | 5 | 4 | 1 | 5 | 11 | 5 | 5 |
| UWO | 6 | 3 | 2 | 5 | 20 | 6 | 6 |
| CITY-1 | 4 | 3 | 1 | 4 | 14 | 4 | 4 |
| CITY-2 | 8 | 5 | 2 | 8 | 17 | 8 | 8 |
| CITY-3 | 10 | 5 | 3 | 10 | 12 | 10 | 10 |
| CITY-4 | 11 | 6 | 2 | 9 | 17 | 11 | 11 |
| CITY-5 | 9 | 4 | 3 | 9 | 19 | 9 | 9 |

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## Appendix C    Result

Table 1 (ASPPR-I, a variation of ASPPR achieved by omitting automatic plane optimization; GT, the number of the ground truth planes; IRP, interactive region partitioning; API, automatic plane inference; IPM, interactive plane modification; APO, automatic plane optimization.) shows the quantitative reconstruction results of the proposed methods. It was observed that the proposed method can produce satisfactory results.

   Table 2 shows the average reconstruction accuracies for the proposed methods in terms of the AP and AR. Note that, the planar regions corresponding to the planes are produced interactively, and thus it is not changeable for automatic plane inference and automatic plane optimization.

Table 2.  Average accuracies

| Dataset | AP | | AR |
|---|---|---|---|
| | API | APO | |
| TS | 0.6713 | 0.7967 | 0.9881 |
| LSB | 0.6386 | 0.7607 | 0.9593 |
| AC | 0.7034 | 0.8295 | 0.9789 |
| UWO | 0.6683 | 0.7749 | 0.9568 |
| CITY | 0.5932 | 0.7486 | 0.9545 |

**References**

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