3D Modeling on the Go: Interactive 3D Reconstruction of Large-Scale Scenes on Mobile Devices

Supplementary Material

Thomas Schöps Torsten Sattler Christian Häne Marc Pollefeys
ETH Zurich, Switzerland
{thomas.schoeps, torsten.sattler, christian.haene, marc.pollefeys}@inf.ethz.ch

1. Offline reconstruction results

In Fig. 1, we present an addition to Fig. 10 in the main text which did not fit the space requirements of the paper. The dataset shown in the images consists of 6810 frames recorded in 3:50 minutes. The trajectory length is 172 meters. Bundle adjustment took 4:20 minutes on this dataset, 3D reconstruction using the proposed system took 6:02 minutes.

2. Evaluation of all component combinations

In Tab. 4 in the main text, only the tests for leaving out one component at a time are shown due to space constraints. In Tab. 1 we show the same statistics for all possible combinations. The columns C, A, V, S, M, R correspond to components; A component is enabled if it is marked with an 'x' in the respective column and disabled otherwise. The letters are as follows:

C Connected component analysis
A Angle filtering
V Variance filtering
S Speed (consistency) filtering
M Median filtering
R Multiresolution

In the following we shortly analyze the effects of the individual components by looking at the model accuracy and completeness values.

Connected component analysis increases model accuracy in all cases compared to leaving it away. Completeness generally drops if the model is accurate, as some data is filtered away, but may increase if the model is inaccurate.

Both angle and variance filtering usually cause a small difference only with our settings if the mesh is already accurate. They then tend to increase accuracy slightly at the expense of completeness. If the mesh without filtering is inaccurate, enabling it has a larger effect and more often also increases completeness.

Speed filtering (consistency checking over time) is very effective at improving accuracy and removing outliers; it thus is the most important filter for creating reconstructions with few outliers. As expected, completeness drops when enabling it for reconstructions which are already accurate without speed filtering.

Median filtering usually slightly decreases accuracy, which is justified by sometimes large gains in completeness.

Multiresolution generally increases the completeness, as in the combined stereo matching window from all resolutions there may be structure while the window spanning the smallest area (on the highest resolution) may be textureless. However, accuracy is often slightly lower when using multiresolution, as matching costs are simply averaged in our system, such that pixels which can be precisely located on the highest resolution image may be degraded by lower-resolution estimates.

The proposed configuration (with all components enabled) represents a good compromise between a low number of outliers and high completeness.
Figure 1. Images of a model generated from the Zurich Münzplatz dataset. The voxel resolution was set to 4 cm to keep the mesh size manageable. Trajectories are shown in red. *Left:* Input image examples. *Right:* Orthographic projection showing the whole reconstruction from the top, and selected close-ups.
|                | C    | A    | V    | S    | M    | R    | Depth map | Acc.     | Comp. | Model Out. | Acc. | Comp. | Living room 0 | x | 69.7% | 52.4% | 22.6% | 68.2% | Underpass | x | 74.6% | 67.8% | 85.2% |Living room 0 | x | 70.5% | 52.3% | 23.3% | 67.0% | Underpass | x | 75.2% | 67.7% | 87.9% |Living room 0 | x | 71.9% | 53.5% | 26.1% | 63.9% | Underpass | x | 80.3% | 59.5% | 44.4% | 42.5% | Living room 0 | x | 92.6% | 37.2% | 84.4% | 3.6% | Underpass | x | 89.6% | 44.1% | 93.3% | Living room 0 | x | 92.4% | 36.0% | 86.6% | 5.4% | Underpass | x | 89.3% | 45.2% | 95.4% | Living room 0 | x | 93.2% | 34.9% | 89.5% | 2.5% | Underpass | x | 89.9% | 43.6% | 92.9% | |