Exercise 4 Solution

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1 Exercise 3: Bundle Adjustment

what a robust loss function such as Huber does and why we should use it here, but not in the calibration from sheet 2?

A loss function such as Huberloss can reduce the influence of outliers. For exercise 2 calibration we are optimizing the camera poses and camera intrinsics, there are no outliers. So we don't use loss function in the calibration from sheet 2.
Using a robust loss function such as Huberloss, the cost for large residuals is reduced.

Huberloss:

$$p(s) = \begin{cases} s & s \leq 1 \\ 2\sqrt{s} - 1 & s > 1 \end{cases}$$

2 Exercise 4: Outlier Filtering

Have a look at remove outlier landmarks and describe the different implemented criteria to detect outliers. For each criterion, what do you think might be the cause of such an outlier and why do we need to remove it?

There are four basis criterion:

1. Huge re-projection error. Maybe because of wrongly match.

2. Large re-projection error, which is only removed if no other types of outliers are present. Maybe because of wrongly match.

3. The distance to camera is too small, which may correspond to outlier matches or points stuck in local minima. Usually the object can't be too close to the camera.

4. too small z coordinate,which may correspond to outlier matches or points stuck in local minima. Usually the object can't be too close to the camera.

3 Exercise 5: Building a Map

How many cameras can be added to the map? How long does it take? Which parts of the pipeline are taking the most time? Do you have any suggestions on how to maybe speed up the map building process?

164 cameras, 4670 landmarks can be added to the map. It takes about 160 seconds. Optimizing step takes the most time.
For speeding up, maybe not always using all cameras and landmarks for bundle adjustment.

Now try again using match bow (take care to clear the cached matches). What difference do you observe?

The map has 158 cameras and 4080 landmarks. Fewer cameras and landmarks were added in the map compared to match_all. Since match_bow have only half of the matchs compared to match_all.
match_bow: Successfully matched 457 out of 3649 image pairs with a total of 23982 inlier feature matches (43848 total).
Match_all: Successfully matched 1012 out of 13284 image pairs with a total of 44397 inlier feature matches (109579 total).

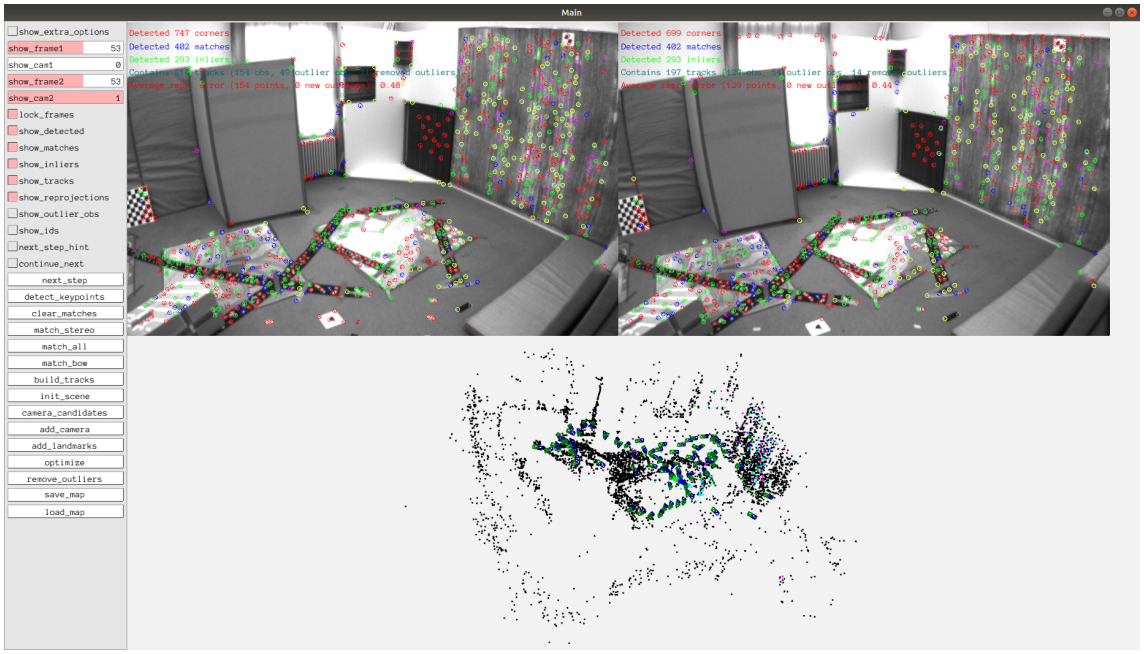

Figure 1: result