Assignment 2 report

Emily Jia 7297802005

Compute reprojection error

To compute reconstruction error, we need to project the 3d point from `self.point_cloud` and compare them with their corresponding 2D image points. The `ref` array saved in `self.image_data` stores the corresponding `idx` in `self.point_cloud` for every keypoint. If `ref == -1` , then that keypoint have no corresponding 3D point in `self.point_cloud` .

After the 2D-3D pairs are got, the projections of 3D points are computed using `cv2.projectPoints` function. I chose mean L2-distance between keypoints and their projection as reprojection error metric.

Visualize reprojection

Keypoints and their projections are first round to integer and then plot as blue and green dots on the image, respectively. I also connect each pair using red line. However, the reprojection error is so small that the red line can not be seen.

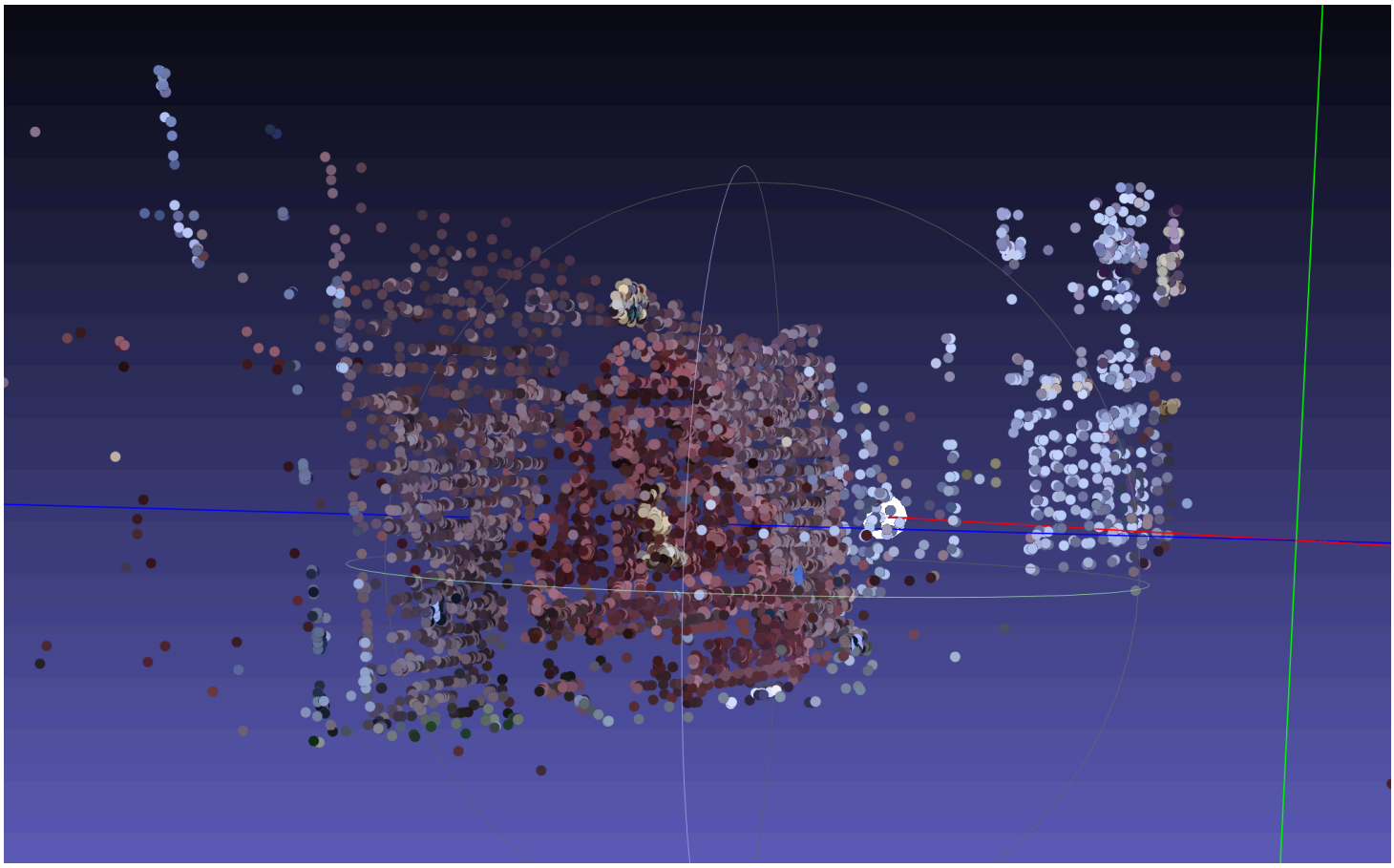
Triangluate new view

For every keypoint in current view, we try to find its correspondence with un-matched keypoints in previous views. If there exists multiple matches, the one with smallest view index is chosen for triangluation.

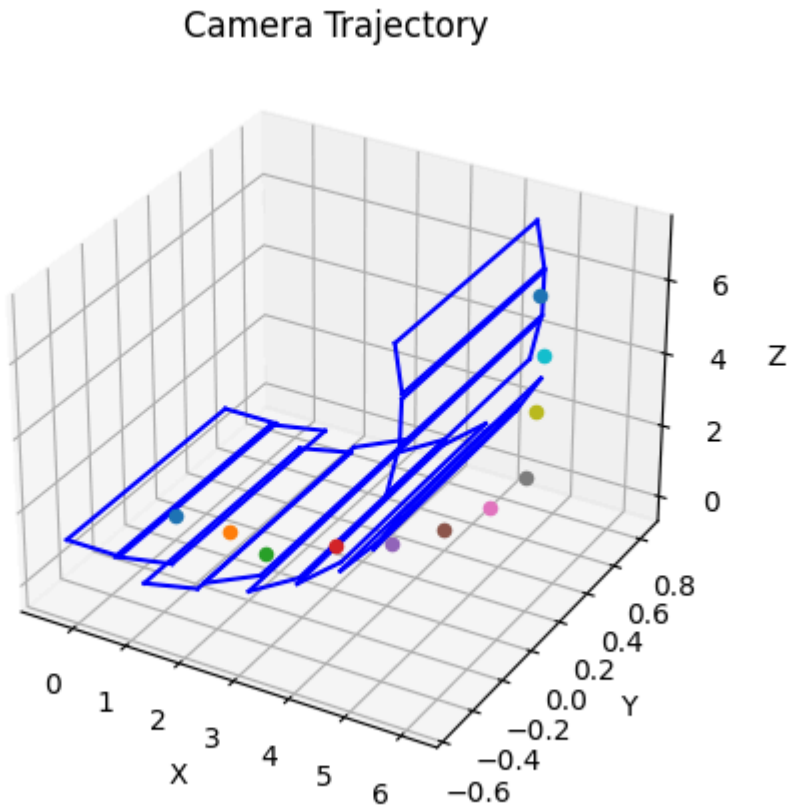
To get a cleaner point cloud, we reject the matches with large projection error. In detail, we first compute triangluation results for all possible matches and then reproject the 3D points to both current view and the previous view. The 3D point is accepted if its reprojection errors to both views are below 8 (as set in `--reprojection_thres` , which is also used in `PnPRansac`).
Otherwise the point will not be added to `self.point_cloud` .

Results

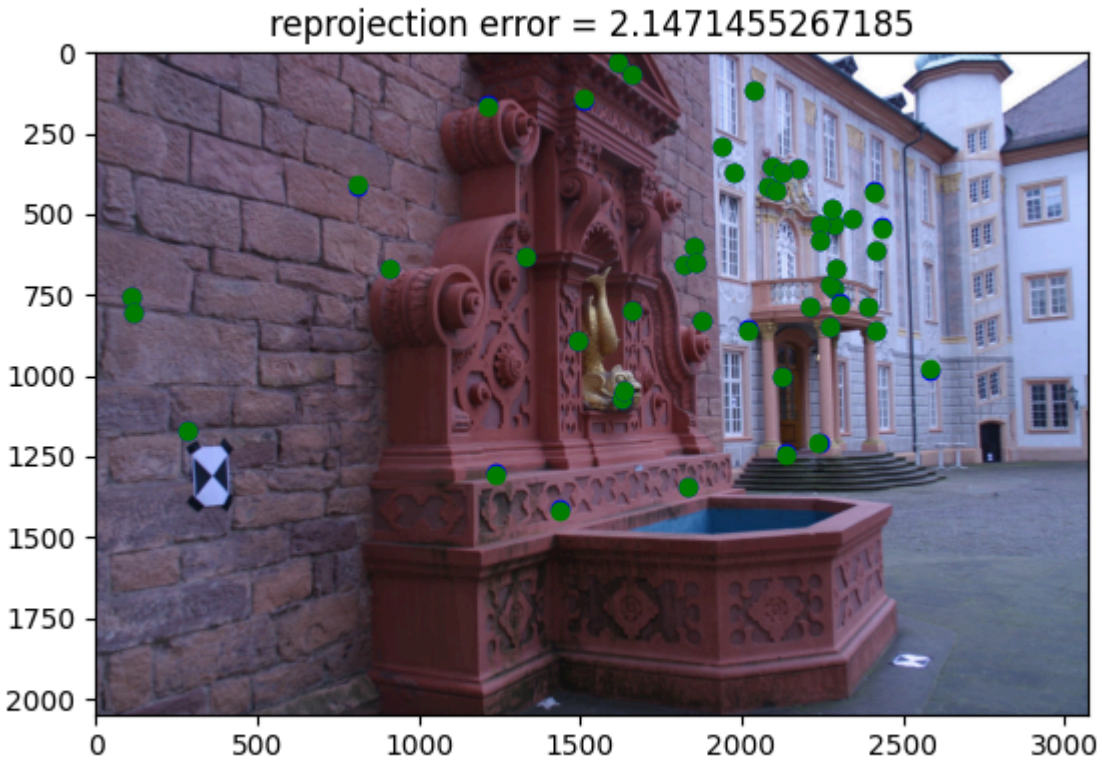
The point cloud for `fonutain-P11` is shown below:



Camera trajectory:



Reprojection error image for final view is shown below:



Run time output from `sfm.py` :

```
Baseline Cameras 0000, 0001: Pose Estimation [time=0.0408s]
Baseline Cameras 0000, 0001: Baseline Triangulation [time=0.00108s]
Camera 0000: Reprojection Error = 0.47835992632447333
Camera 0001: Reprojection Error = 0.4911547128245299
Camera 0002: Pose Estimation [time=0.1s]
Camera 0002: Triangulation [time=0.0536s]
Camera 0002: Reprojection Error = 0.5988457592941052
Camera 0003: Pose Estimation [time=0.137s]
Camera 0003: Triangulation [time=0.0714s]
Camera 0003: Reprojection Error = 0.3133971242941366
Camera 0004: Pose Estimation [time=0.153s]
Camera 0004: Triangulation [time=0.0889s]
Camera 0004: Reprojection Error = 0.4218107686838128
Camera 0005: Pose Estimation [time=0.17s]
Camera 0005: Triangulation [time=0.105s]
Camera 0005: Reprojection Error = 0.3772289425042508
Camera 0006: Pose Estimation [time=0.209s]
Camera 0006: Triangulation [time=0.132s]
Camera 0006: Reprojection Error = 0.43571368173197944
Camera 0007: Pose Estimation [time=0.235s]
Camera 0007: Triangulation [time=0.151s]
Camera 0007: Reprojection Error = 0.4490799768122023
Camera 0008: Pose Estimation [time=0.295s]
Camera 0008: Triangulation [time=0.178s]
Camera 0008: Reprojection Error = 0.7471872332844111
Camera 0009: Pose Estimation [time=0.355s]
Camera 0009: Triangulation [time=0.196s]
Camera 0009: Reprojection Error = 0.606888480189333
Camera 0010: Pose Estimation [time=0.438s]
Camera 0010: Triangulation [time=0.227s]
Camera 0010: Reprojection Error = 2.1471455267185
Reconstruction Completed: Mean Reprojection Error = 0.6424374666056122 [t=3.33762s], Results stored in ../../assets/assignment2/results/
```