Rajat Bhageria
CIS 580
25 April 2018
Final Project Report
Milestone 1

Camera Rectification and Structure from Motion

1. Method:

1) Parse the correspond data between the 6 images from 6 different poses
2) Get the correspondences between the desired two images
3) Run RANSAC and for each set of 8 random points, compute the fundamental matrix using 0 = x2Fx1; run for k iterations (k=10,000) with epsilon = 0.005 till you get the max number of inliers.
4) Use all the inliers to recompute the a new fundamental matrix
5) Convert the fundamental matrix to a essential matrix
6) Find the possible camera poses for camera two (assuming camera one is at the origin) from the essential matrix
7) For each of the possible camera pose, triangulate the 3D points
8) Disambiguate the camera poses and find the correct camera pose for camera 2
9) Plot all the point clouds and the reprojection of the 3D points to the image plane

2. Results:

Here are some of the results achieved for image 1 and 2

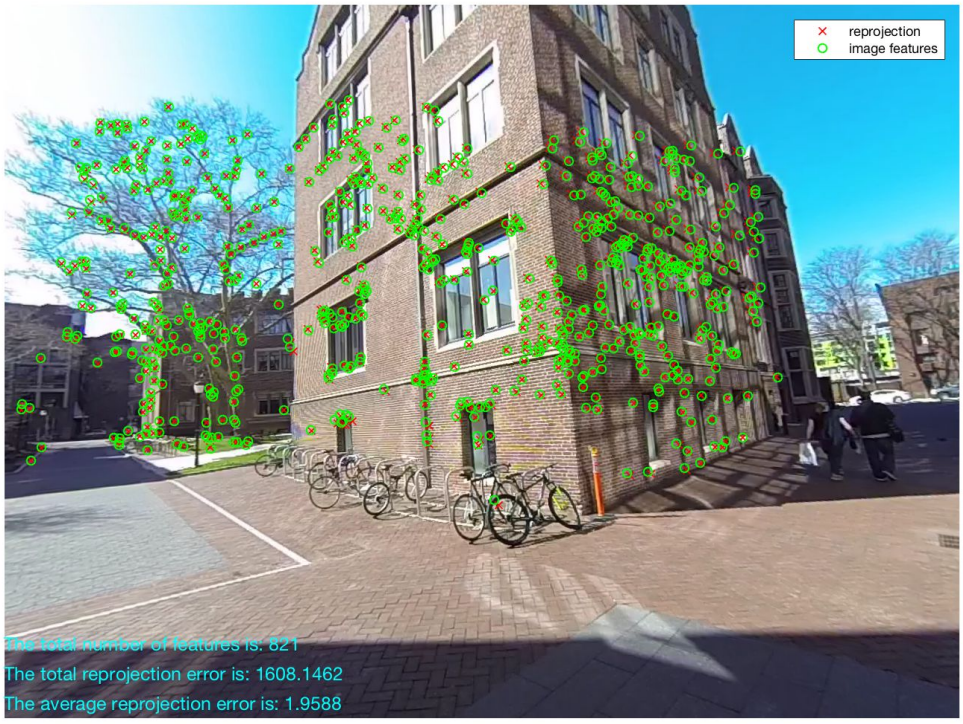

Figure 1: Final image reprojection between images 1 and 2: Note that the average reprojection error is around 1.9588 and the total error is around 1608.1462 with 821 features.

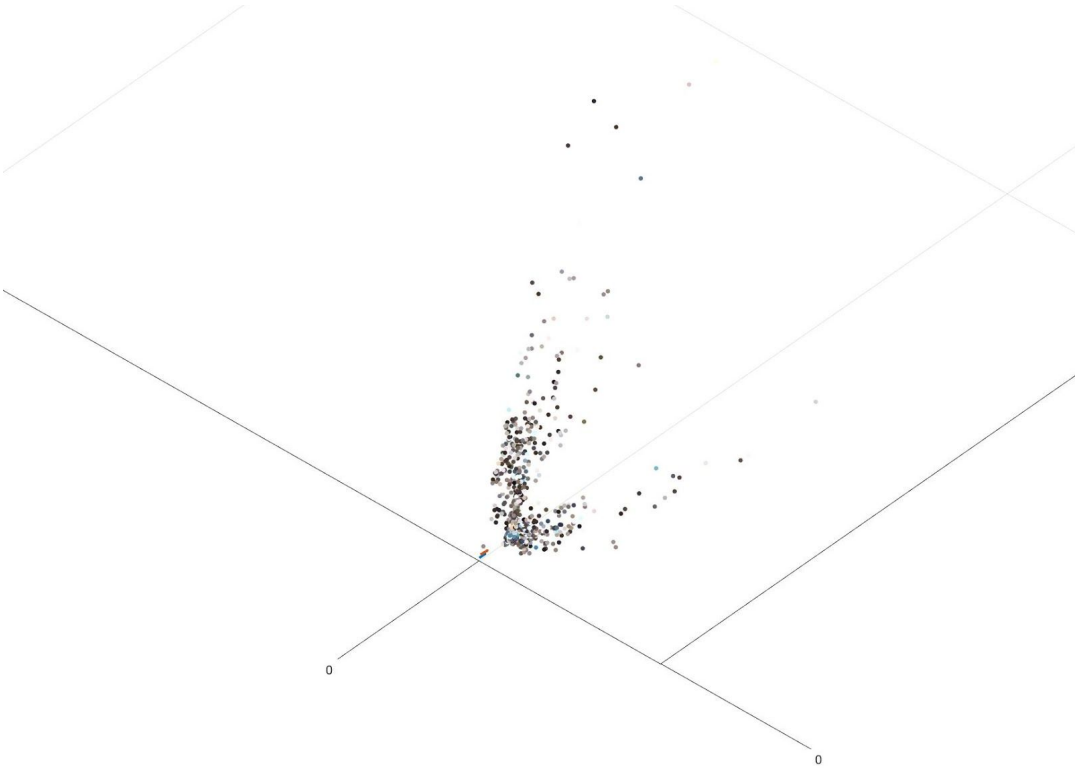

Figure 2: A image of the point cloud with the RGB points

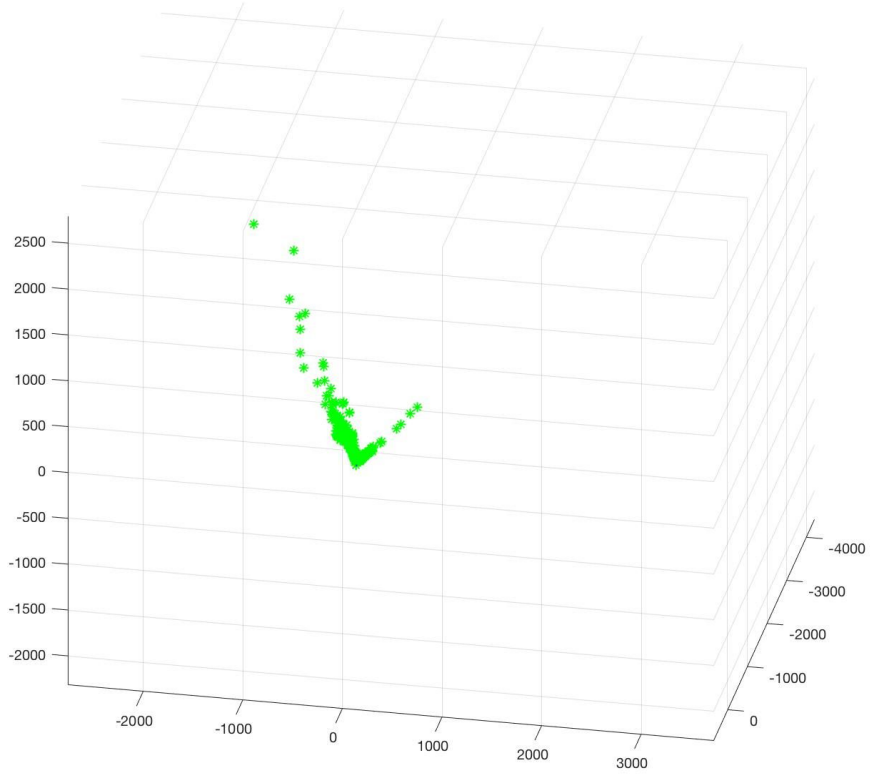

Figure 3: Here's a version of the point cloud generated from the top

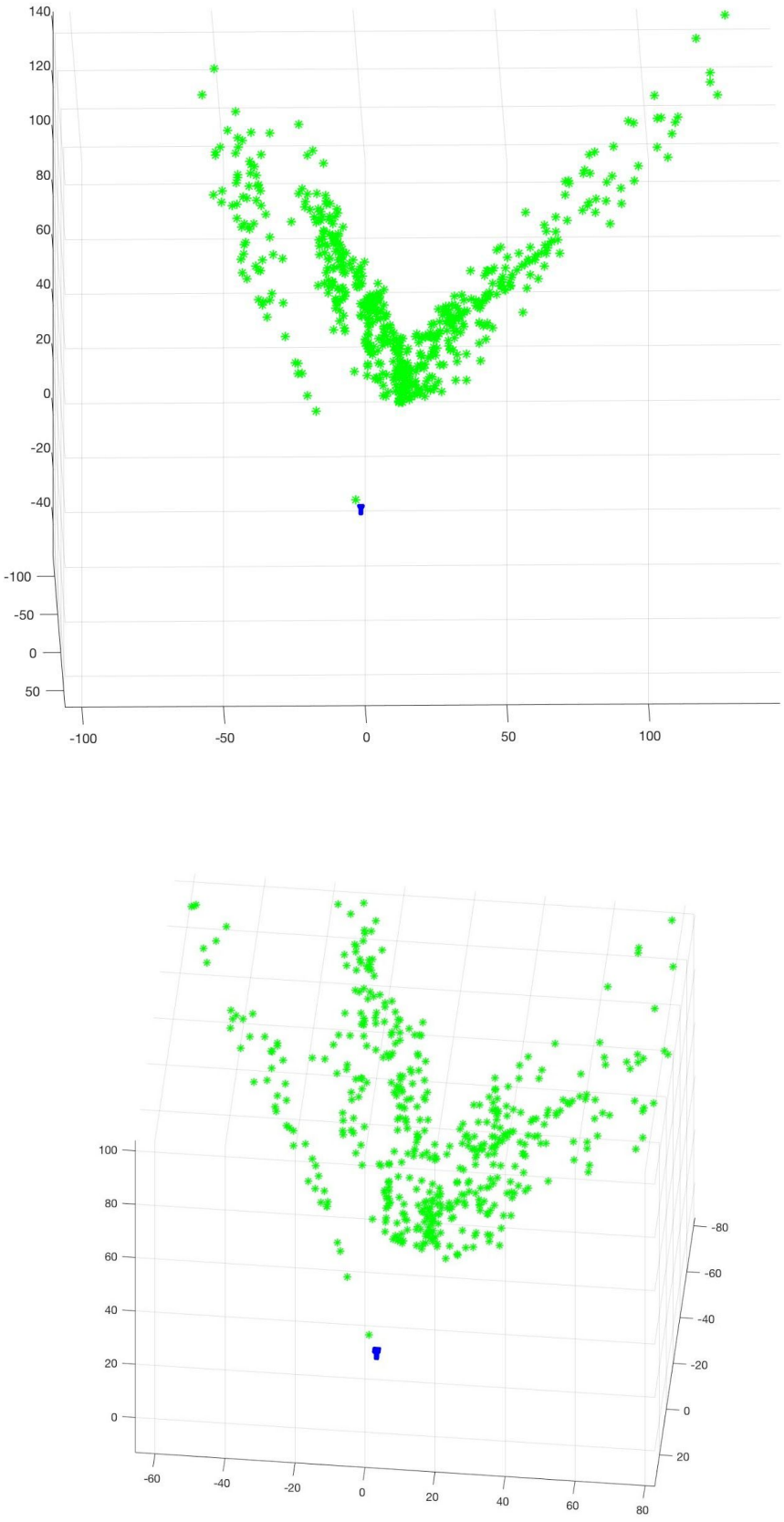

Figure 4: Closeups of the point cloud with both cameras visible

3. Analysis:

The program is reproducible so that one can run the reprojections between different sets of images.

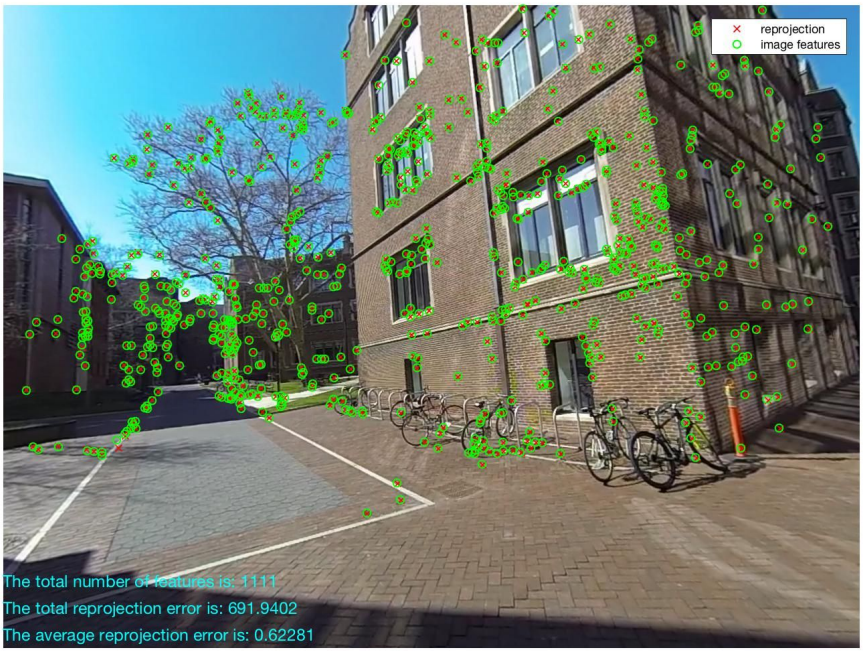

Figure 5: A reprojection between images 3 and 4. Note that the average reprojection error is around 0.62881 and the total error is around 691.9402 with 1,111 features.

Interestingly the results between this set of images is better than the results between images 1 and 2. This may be simply because there was more 1:1 correspondences between images 3 and 4 than between 1 and 2.

We can also test how well the RANSAC works. Here's a graph of the reprojections between image 1 and 2 without RANSAC.

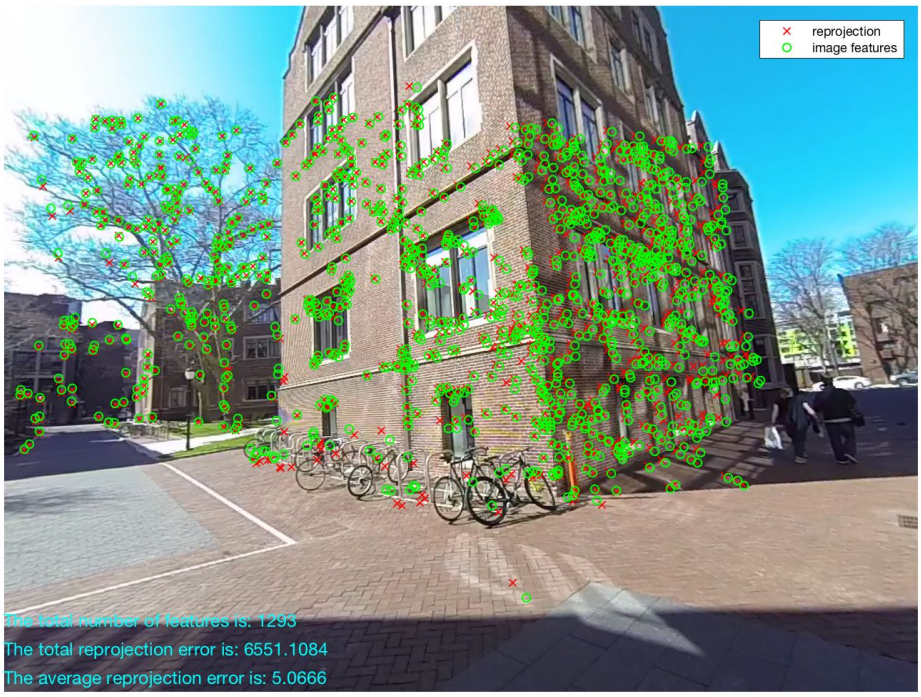

Figure 6: A reprojection between images 1 and 2 without using RANSAC.

Note that compared with the 809 points after using RANSAC and the 1293 points using RANSAC. This leads to an average error of around 5.0666 and a total error of 6551.1084 (compared with an average error of 2.2723 and the total error is around 1838.2882). In other words, RANSAC made a significant difference on the results and on reducing the errors.

4. Failed Attempts:

Here are some failed images with buggy code:

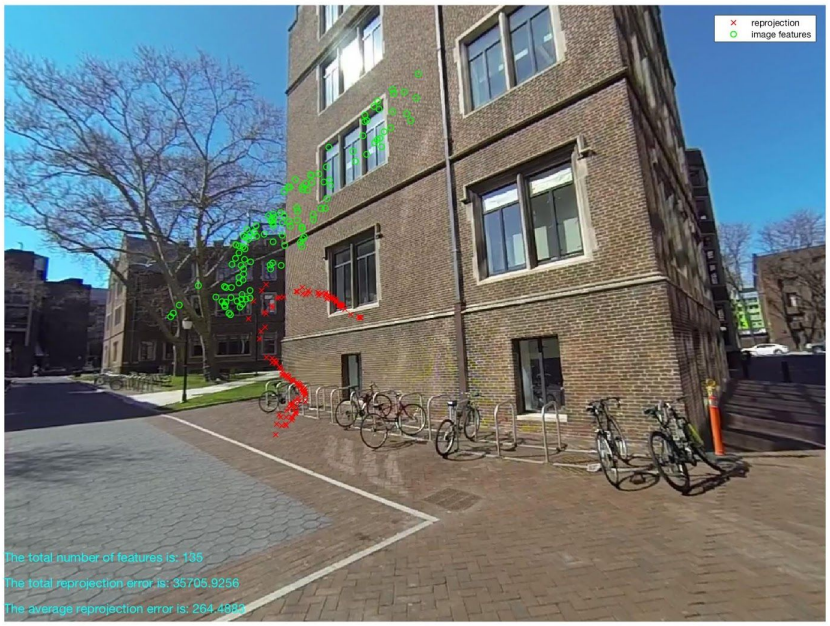

Figure 7: With a RANSAC bug resulting in too little features
And also a reprojection bug because of the bugs in triangulation

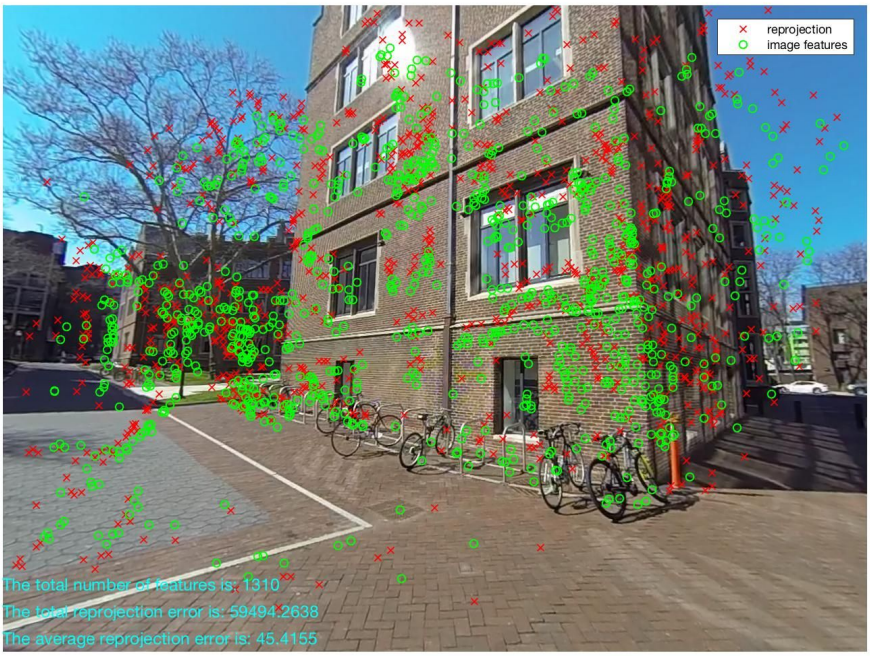

Figure 8: But in disambiguate camera pose