Structure From Motion & Model Fitting
Computer Vision Lab 07 Report
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Abstract

The report is divided into two main sections: **Structure From Motion** and **Model Fitting**. In both sections, the respective implementation steps are described in the provided code and the results obtained are shown and discussed.

1 Structure From Motion Results

For this part of the project, I decided not to report as usual the explanation of all the implementation steps performed, since it is not explicitly required by the handout. However, I have added various comments to the implemented parts, to help the reader better understand the code.

Figure 1 shows the results obtained using the default setting (`init_images` = [3, 4]) and all the provided images (from `0008.png` to 0009.png).

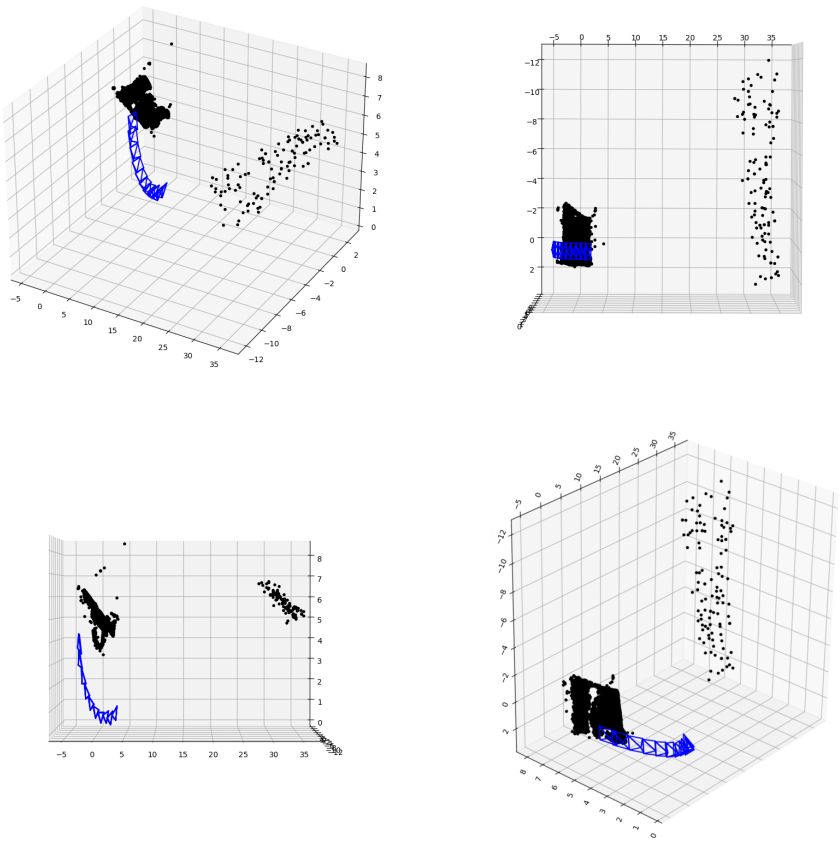

Figure 1: Result views

As can be seen from the obtained results, the reconstruction of the object of interest, i.e. the fountain, was successful (bottom left reconstruction in the 4^{th} image). It is also possible to note the presence of additional points in the 3D reconstruction, potentially due to the presence of the key points on the right side of the last two images, i.e. 008 and 009, as shown in Figure 3. These are distant keypoints but they still perfectly match.

Figure 2: 0008.png keypoints

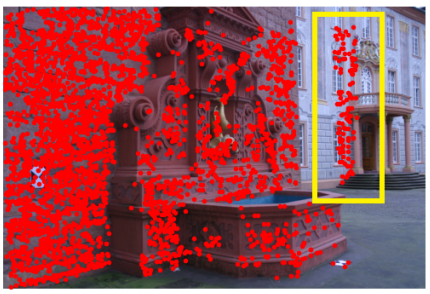

Figure 3: 0009.png keypoints

Indeed, if the pipeline is run without those two final images, the result obtained clearly shows an optimal reconstruction of the object of interest, as shown in figure 4.

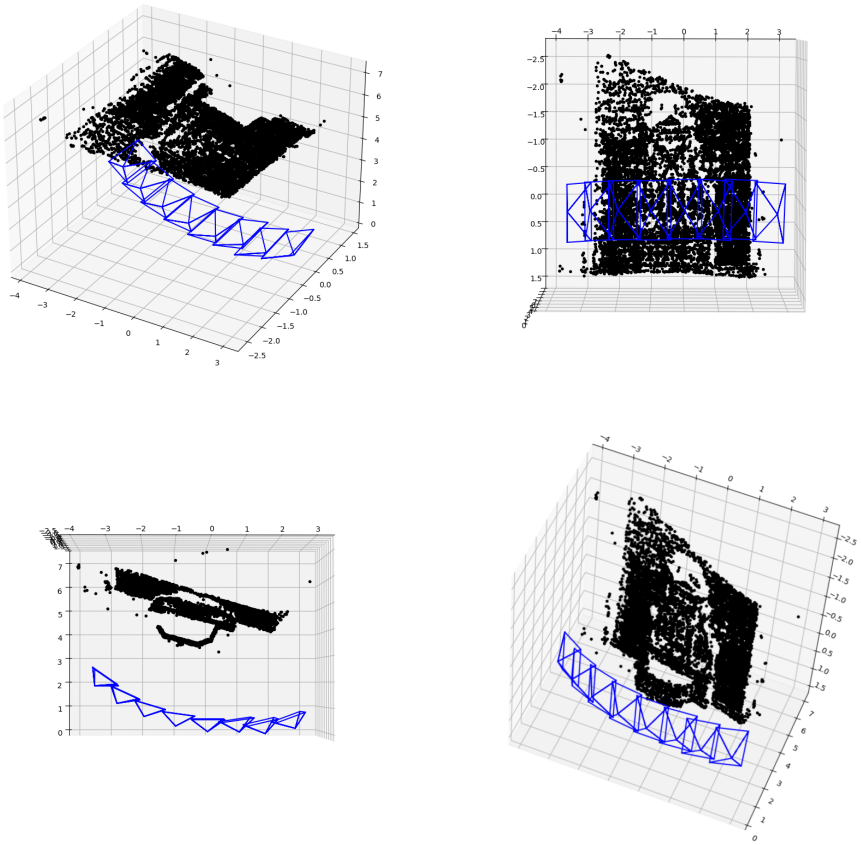

Figure 4: Result views

2 Model Fitting Results

Similar to what has been done previously, I have decided not to report as usual an explanation of all the implementation steps performed, since it is not explicitly required by the handout. However, I have added several comments to the implemented parts to help the reader better understand the code.

As requested by the handout, I report below the ground truth, estimation from least-squares and estimation from RANSAC for `k` and `b`:

```
Estimated coefficients (true, linear regression, RANSAC):
1 10 0.6159656578755458 8.961727141443642 0.9893824756873283 10.027468068986913
```

Figure 5 shows the obtained result. We can observe the contrasting behaviors of a linear regression model and a RANSAC regressor when applied to a dataset with a significant number of outliers. Linear regression attempts to minimize the distances between the data points and the line itself. This method is clearly influenced by the presence of outliers, resulting in a regression line that does not accurately represent the central trend of the majority of the data. Conversely, the RANSAC regresso demonstrates its robustness to outliers by constructing a model based on what it identifies as inliers (green points), effectively ignoring the outliers (yellow points). This approach yields a fitted line that aligns closely with the true underlying relationship of the inlier data points, illustrating the efficacy of the RANSAC algorithm in producing a reliable linear model even in the presence of data points that deviate substantially from the general trend.

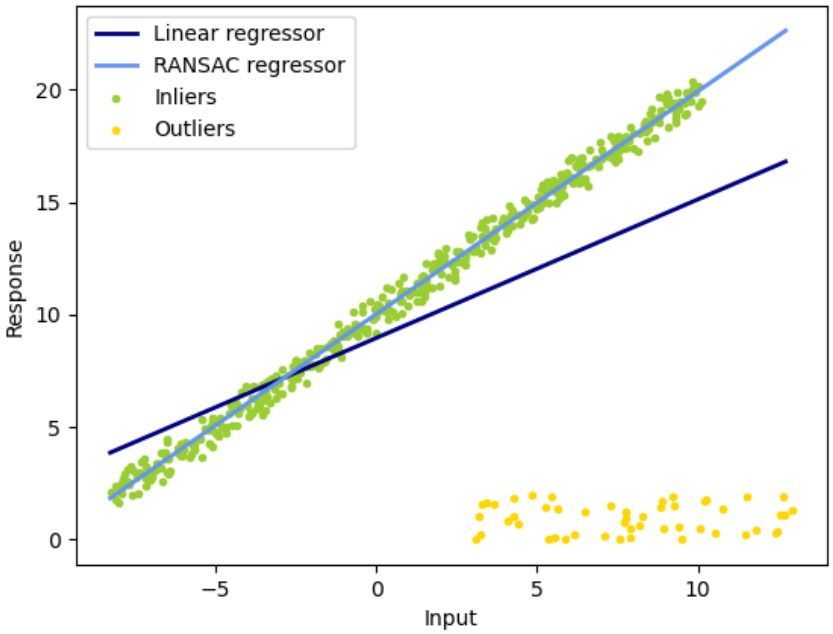

Figure 5: Result