

EE417 - Assignment №3

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I. INTRODUCTION

In this assignment we were asked to use basic techniques of 3D scene reconstruction with 2 images of the same scene, but from different angles. This report will explain the whole pipeline.

II. CAMERA CALIBRATION

Let's start with camera calibration. I was taking pictures on my phone and I took 17 pictures of printed chess board paper at different angles and distances.

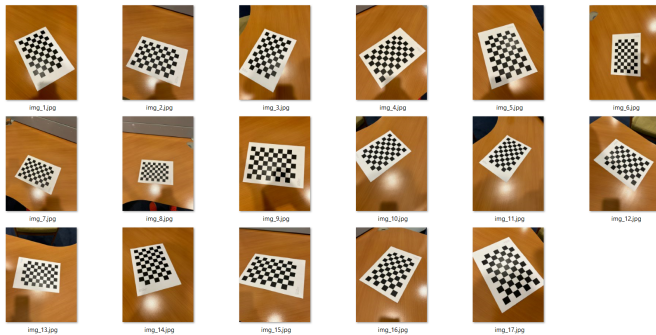


Fig. 1. Calibration images.

The code for computing a camera intrinsic matrix is in the file named "camera_calibration.ipynb". It saves these values into a txt file, which is then read in the "main.ipynb" code.

III. IMAGES

I took 2 images of the working table in the Information Center from different angles.

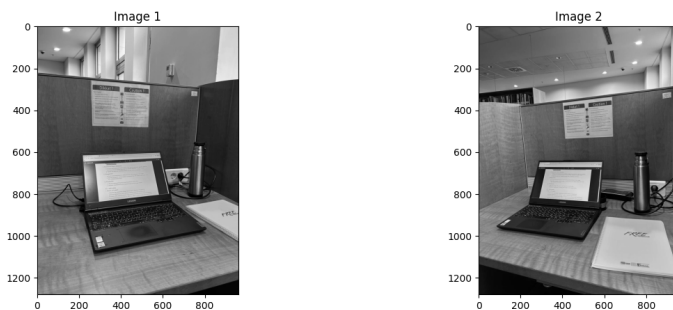


Fig. 2. Images for the Project.

These 2 images will be used in this project.

IV. PIPELINE

I have started with feature detection and matching. First, I have implemented SIFT and then ORB methods. In both cases, I have used RANSAC to get rid of outliers and bad matches.



Fig. 3. Matched Keypoints with SIFT detector.

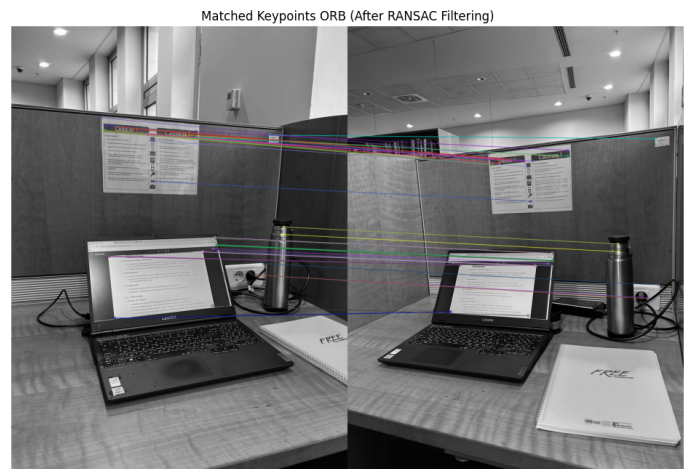


Fig. 4. Matched Keypoints with ORB detector.

ORB detector detects fewer matches, but performs faster. I have calculated a fundamental matrix for both detectors, and my pipeline contains a solution that implements both methods. The next step was to draw a cloud of points in 3D:

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Fundamental Matrix using SIFT:
[[ 1.10146150e-07  1.21276945e-06 -8.90334206e-04]
 [ 1.00525560e-06 -5.11337139e-08 -3.46277110e-03]
 [-5.40385668e-04  2.08176352e-03  1.00000000e+00]]
Fundamental Matrix using ORB:
[[ 7.38647281e-08  2.08612748e-06 -1.31627810e-03]
 [-8.26168365e-08  2.77434109e-07 -2.91042234e-03]
 [ 1.04771715e-04  1.25112731e-03  1.00000000e+00]]

```

Fig. 5. Fundamental Matrices for 2 Detectors.

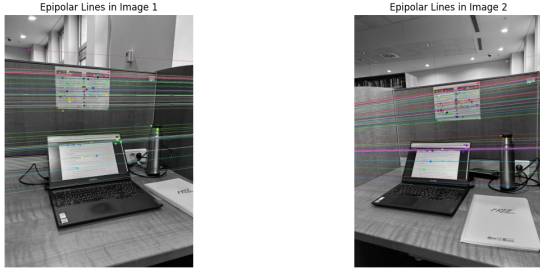


Fig. 6. Epipolar Lines of SIFT detector.

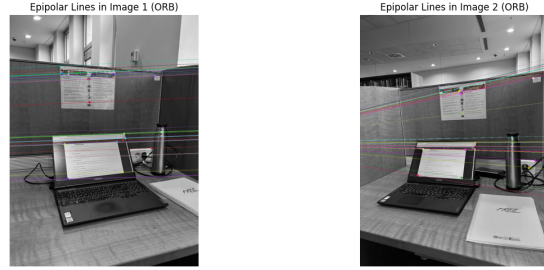


Fig. 7. Epipolar Lines of ORB detector

V. CONCLUSION

I compared ORB and SIFT for 3D reconstruction and noticed that SIFT gives more points in the 3D cloud. This is because SIFT detects more accurate and distinctive keypoints, which leads to better matching and more reliable triangulation. So for my project, SIFT seems to give better reconstruction results than ORB.

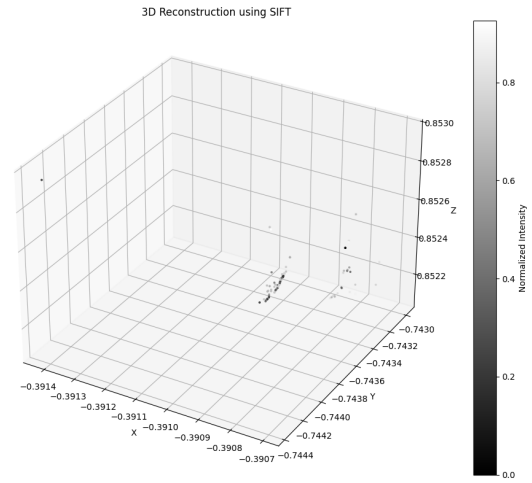


Fig. 8. Calculated 3D points using SIFT.

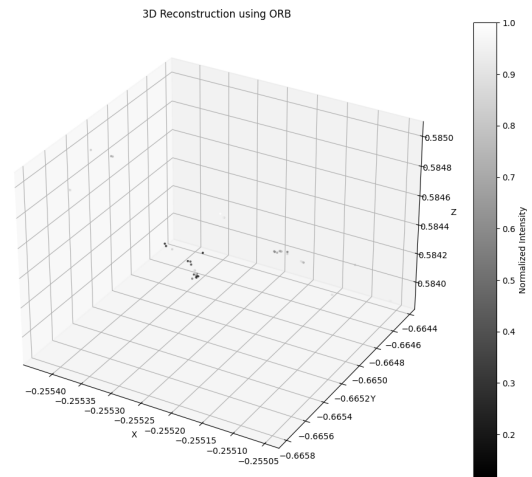


Fig. 9. Calculated 3D points using ORB.