CMPE 264 - Project Assignment 2

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(a) Image 1 (b) Image 2 (c) Image 3

Figure 1. Pictures taken from different distances and directions

(a) Image 1 (b) Image 2 (c) Image 3

Figure 2. Undistorted pictures.

1. Camera radiometric calibration

2. Take the pictures

We use the same camera and lens take 3 pictures as shown in Figure 1. We placed some objects in the front and also left enough distant background.

3. Compute the essential matrix of all three camera pairs

We first undistort pictures with calibration parameters as shown in Figure. There were 25 pixels loss in height and 12 pixels loss in width. Straight lines in those images confirms the calibration was done correctly.

In order to get pixel pairs over 3 camera pairs, we built a tool to allow us to pick those pixel pairs by hand. Figure 2 shows the interface of our tool.

For each camera pair, we picked 17 to 18 pixel pairs to provide enough data calculating essential matrices and fundamental matrices. Figure 4 shows the pixel pairs we picked over 3 camera pairs.

The essential matrices we calculated are

$$E_{12} = \begin{bmatrix} -2.944\text{e}{-07} & -1.993\text{e}{-06} & 2.051\text{e}{-02} \\ 3.242\text{e}{-06} & -9.280\text{e}{-07} & -2.045\text{e}{-02} \\ -2.030\text{e}{-02} & 1.995\text{e}{-02} & 1.000\text{e}{+00} \end{bmatrix}$$

$$E_{13} = \begin{bmatrix} 4.323\text{e}{-08} & 1.144\text{e}{-06} & -1.610\text{e}{-03} \\ -2.850\text{e}{-07} & 2.763\text{e}{-07} & -7.243\text{e}{-03} \\ 5.939\text{e}{-04} & 5.592\text{e}{-03} & 1.000\text{e}{+00} \end{bmatrix}$$

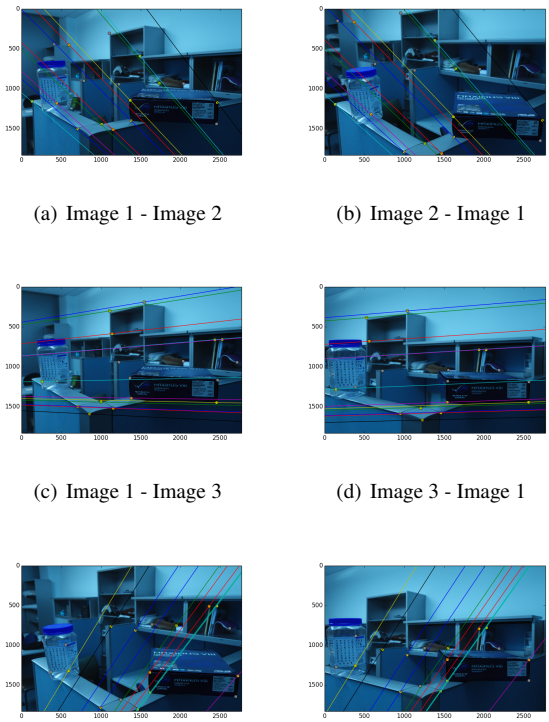
Figure 3. Pictures taken from different distances and directions

$$E_{23} = \begin{bmatrix} 1.608\text{e}{-07} & 2.496\text{e}{-07} & -2.468\text{e}{-03} \\ -1.274\text{e}{-07} & 1.268\text{e}{-08} & -1.230\text{e}{-03} \\ 1.877\text{e}{-03} & 9.439\text{e}{-04} & 1.000\text{e}{+00} \end{bmatrix}$$

4. Acknowledgment

We did all the project together. However, Ziqiang Wang is mainly responsible for Section **??** and Section **??** while Yanan Xie is responsible for the rest parts of this project including providing his professional photography devices.

Thanks to LaTeX for providing such a great document preparation system. And many appreciates to the authors of Python, numpy, sklearn, OpenCV and matplotlib.



(a) Image 1 - Image 2 (b) Image 2 - Image 1

(c) Image 1 - Image 3 (d) Image 3 - Image 1

(e) Image 2 - Image 3 (f) Image 3 - Image 2

Figure 4. Hand-pick pixel pairs (Inliers are yellow while outliers are gray) and corresponding epipolar lines.