ECEN 631 HW3: Stereo Calibration and Rectification

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March 2020

1 Introduction

Stereo calibration and rectification are important tools to master in order to build complex and robust computer vision systems. This homework assignment is designed to allow me to practice these techniques. It is broken up into four sections or tasks, and this report will go into each of those tasks with greater detail.

2 Task 1

In this task I calibrate both the left and right cameras. This is done to benefit the stereo calibration step in task 2. Doing each camera individually results in better stereo calibration results. The intrinsic and distortion parameters are given below.

Table (1) MTX: Left Intrinsic Parameter Array

1735.34	0	336.11
0	1738.59	229.55
0	0	1

Table (2) MTX: Right Intrinsic Parameter Array

1749.02	0	302.96
0	1754.31	207.11
0	0	1

Table (3) MTX: Left Distortion Parameter Array

-4.03207342e-01	-2.21363770e+00	5.43493129e-03	8.86745104e-04	6.66592133e+01

Table (4) MTX: Right Distortion Parameter Array

-5.34661337e-01	1.22793593e+00	4.07589404e-03	5.28141284e-03	6.00480199e+00

3 Task 2

In this task, I use the matrices found in task 1 with the opencv stereoCalibrate() function to calculate the extrinsic parameters, and the essential and fundamental matrices. They are below.

Table (5) Extrinsic Parameters: [RT]

9.99869181e-01	7.63428784e-04	1.61566745e-02	-20.34611274
-9.80185610e-04	9.99909571e-01	1.34122672e-02	-0.04686733
-1.61449741e-02	-1.34263492e-02	9.99779512e-01	2.12880517

Table (6) Essential Matrix

2.84329603e-03	-2.12798341e+00	-7.54091004e-02
1.80003922e+00	-2.71548823e-01	2.03760211e+01
6.68041661e-02	-2.03442371e+01	-2.72130281e-01

Table (7)　Fundamental Matrix

-2.98812706e-07	2.23219142e-04	-3.73878356e-02
-1.88602539e-04	2.83987818e-05	-3.64796978e+00
2.68738461e-02	3.65899423e+00	1.00000000e+00

4　Task 3

In task 3, I calculate and draw the epilines for both the left and right cameras. I choose three points in each camera and calculate their corresponding epiline and plot it in it's opposite cameras frame. Below are the images with the epilines drawn.
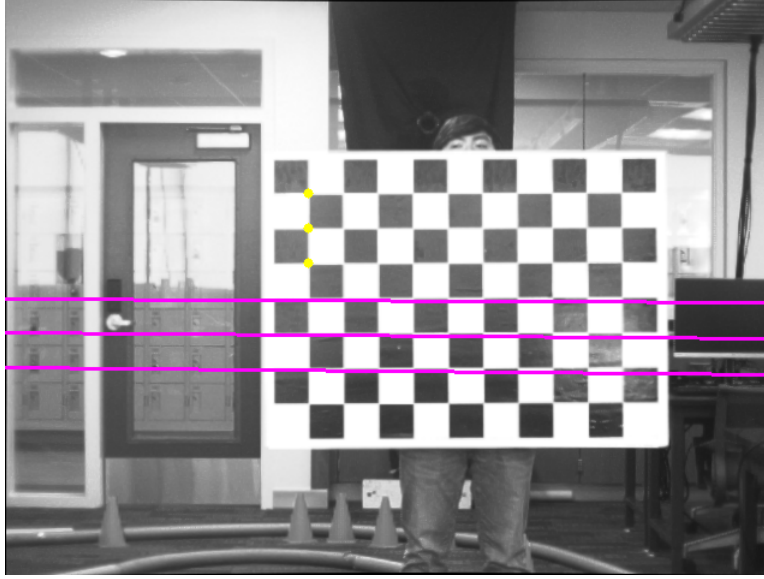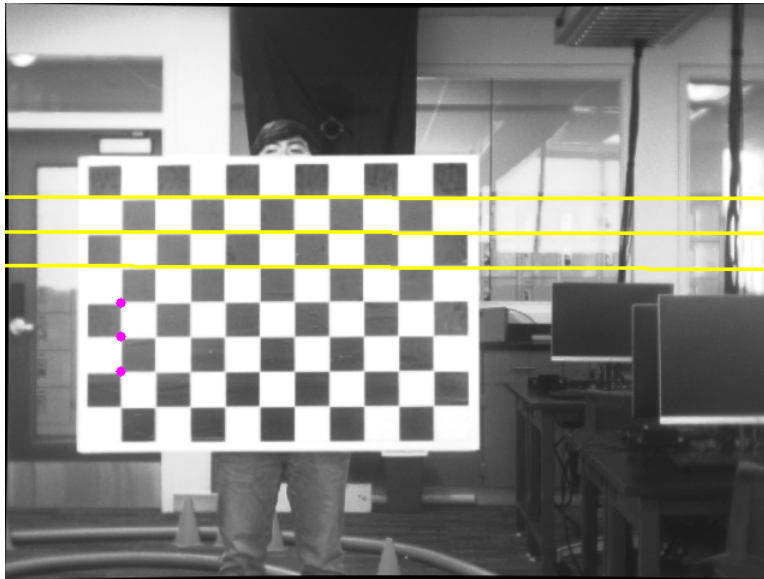

Figure (1)　Right Epilines on Left Image

Figure (2)　Left Epilines on Right Image

5   Task 4

In task 4 I rectify the stereo images. This is done to produce horizontal epilines, and make it so the images are lined up as perfectly as they can be. Below are the images associated with this task.
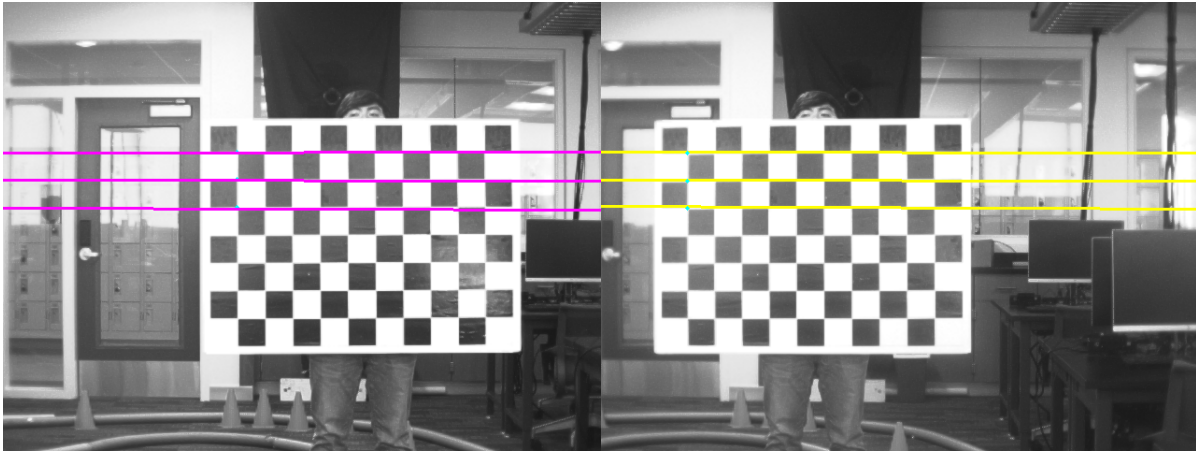

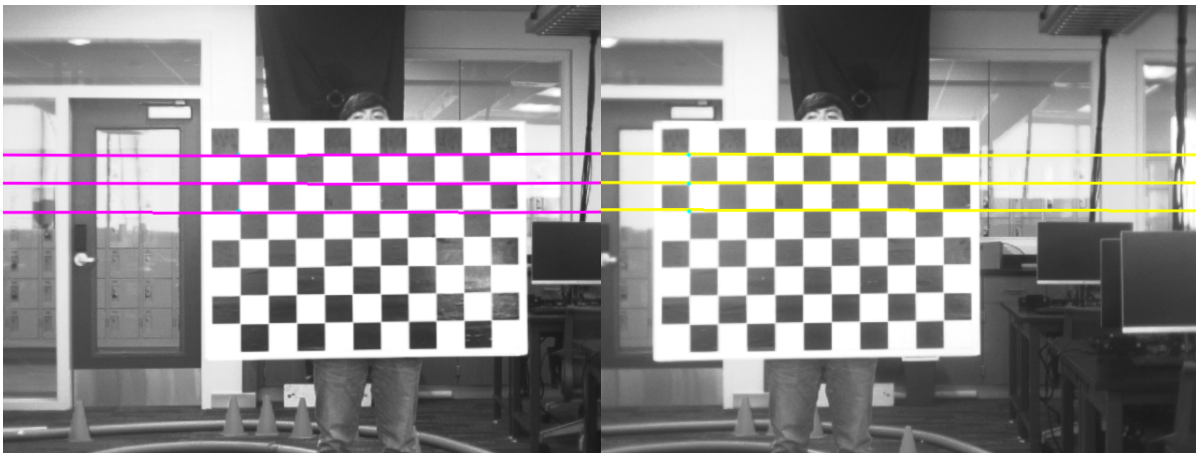Figure (3)   Original Images Side-By-Side

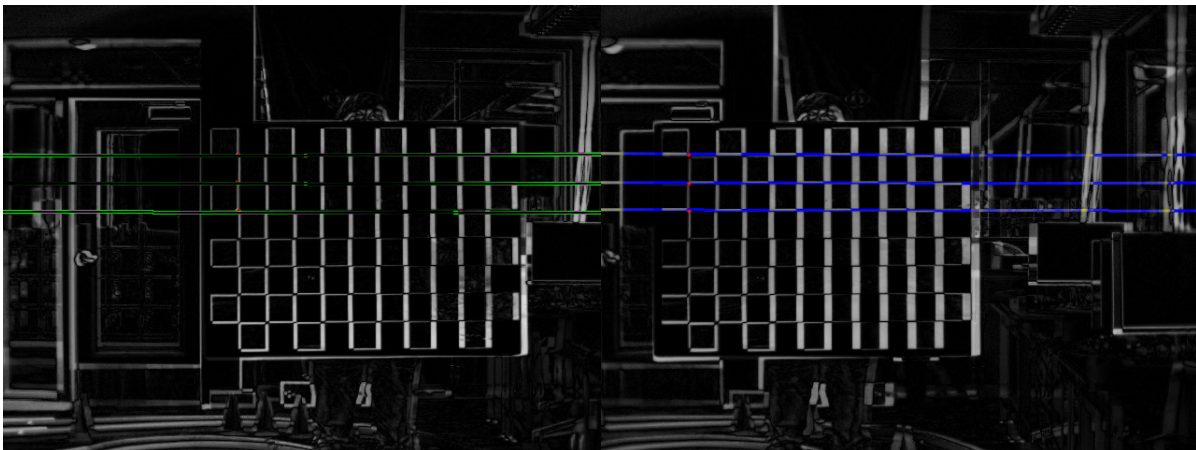
Figure (4)   Rectified Images Side-By-Side

Figure (5)   Difference Images Side-By-Side

I left the epilines on to further demonstrate the affects of rectification. These images show the original frames, rectified frames, and the difference between the original and the rectified frames. The difference is subtle but the images were slightly rectified.

6 Conclusion

The stereo calibration can be used to create robust stereo systems. Further, opencv contains many functions that make this process relatively painless and easy to do.