ECE 8410: Computer Vision

Laboratory 3 Report: Essential Matrix and Epipolar Lines

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Part A: Calculate the Essential Matrix

For this lab, our group reused the two images from the previous lab as well as the defined points on the cube. The two images are shown in Figure 1. As well, the defined cube points were reprojected onto the images so that the transformation results can be verified. The points do line up and are projected properly, shown in Figure 2.

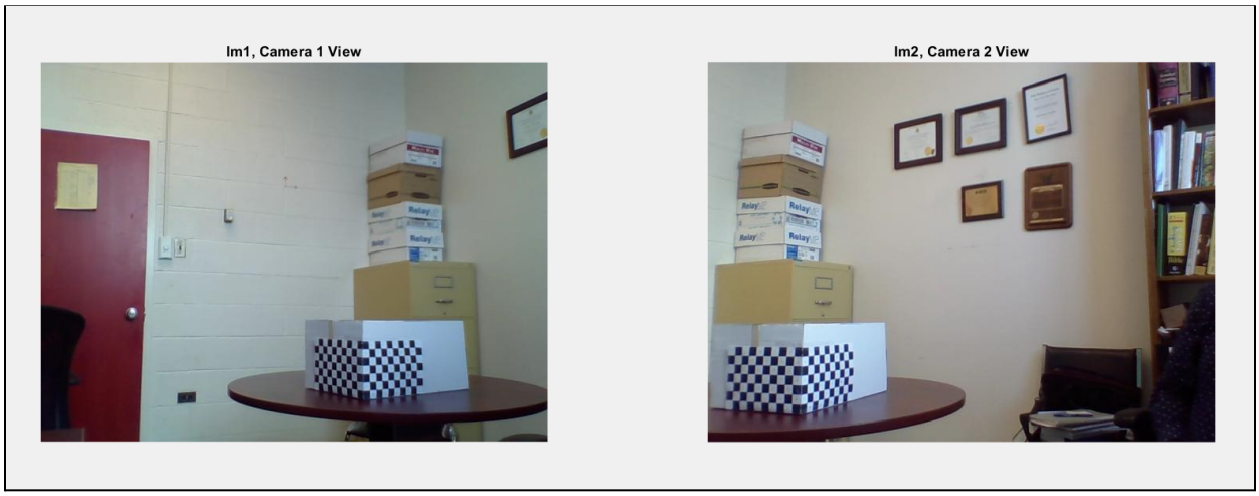

Figure 1: Two camera images used in this lab. The Camera 1 view is the left image, or 'myofficePos1.jpg', and the right image is the Camera 2 view, or 'myofficePos2.jpg'.

Figure 2: Reprojected points using the previous labs camera pose.

As well, since the estimated camera pose was found for these images from the previous lab, the homogenous transform between the two camera views can be found. The code used for the final transformation calculation is shown in Figure 3, and the code that denotes H_m_c1 and H_m_c2 with values from the previous lab can be found in the ‘lab3.m’ file attached with this report submission.

```
% Find Transformation of camera 2 wrt camera 1
H_c2_c1 = H_m_c1 * inv(H_m_c2);
R_c2_c1 = H_c2_c1(1:3,1:3);
Pc2org_c1 = H_c2_c1(1:3,4);
```

Figure 3: Transformation of camera 2 with respect to camera 1 calculation.

Finally, with the camera to camera transformation, the 'true' essential matrix was calculated, shown in Figure 4.

```
% Calculating the essential matrix
t=Pc2org_c1;
E_true = [0 -t(3) t(2); t(3) 0 -t(1); -t(2) t(1) 0]*R_c2_c1;
disp('True E = ');
disp(E_true);
```

```
True E =
    0.5088   -8.0237    0.1532
    0.7085    0.1962   12.6995
    0.6172   -9.8378    0.0705
```

Figure 4: Code used to calculate the essential matrix, and the final essential matrix result.

Part B: Draw Epipolar Lines

Next, using the calculated matrix, Epipolar lines were drawn for each projected point. The code for this was referenced from the material in the notes, but it was modified in order to also draw epipolar lines on the second camera view. The drawn lines on top of the original images are shown in Figure 5.

Figure 5: Epipolar lines drawn on both images.

Part C: Using the 8-point algorithm to compute E

Our group referenced the 8 point algorithm stated in the notes, but instead scaled the final result by E(2,1) instead of -E(1,2). This obtains a result very close to the original true E, so the group was satisfied with the result. It's unclear why we had to make this scaling change, more clarification on this might be worthwhile in the lecture notes.

```
Calculated E =
   -1.0528   16.6810   -0.2297
   -1.8051    3.4108  -28.0614
   -1.2739   20.4174   -0.0224

calculated E after scaling=
    0.5832   -9.2412    0.1272
    1.0000   -1.8895   15.5459
    0.7058  -11.3112    0.0124
```

Figure 6: Calculated E using the 8 point algorithm, before and after scaling.