ECE661: Homework 3

Fall 2016
Deadline : September 13, 2016 , 1:30 pm

Turn in typed solutions via Blackboard. Additional instructions can be found at [I]

1 Introduction

This homework deals with removing projective and affine distortions. Note that in the previous homework you did not remove any distortion from the image, rather it dealt with transforming images based on homographies.

There are two methods for removing projective distortion. First method involves establishing point-point correspondences between image and world plane, and using them to find homography between images. You have already used point-point correspondences in the previous homework to transform images. Here you will use the world coordinates to undistort images. The second method involves finding two pairs of lines in the image that are supposed to be parallel in the world plane and using them to find the homography.

Also there are two methods to remove affine distortion from the image. First one is a two-step method in which first projective distortion is removed and then the affine distortion is removed by using two pairs of orthogonal lines. The second method is a one-step method in which several pairs of othogonal lines are used to directly estimate the dual degenerate conic. Then the affine homography can be obtained from this conic.

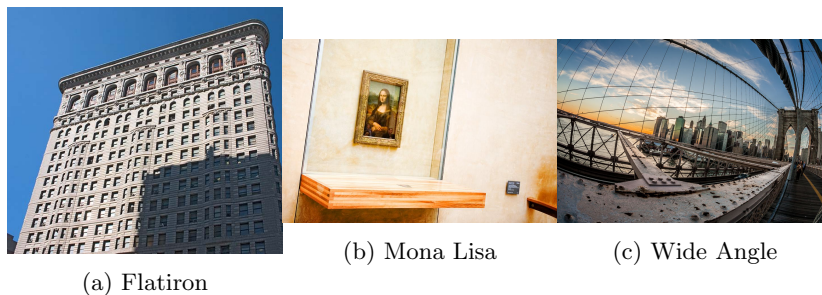The images that you use in the homework are given in Figure 1.

(b) Mona Lisa   (c) Wide Angle

(a) Flatiron

Figure 1

2 Tasks

2.1 2-Step Method

Use two-step method to remove affine-distortion. You can use either of the two methods to remove the projective distortion. Although if you use both the

methods you will get bonus score. You will need the world coordinates if you use point-point correspondences. They can be found at [I].

2.2 Single Step Method

- In this method estimate the dual conic C_∞^* directly using the minimum necessary number of pairs of orthogonal lines.

2.3

1. Comment on you results obtained from different methods.

2. Using at least 2 of your own images repeat tasks 2.1 and 2.2. Note - The images you take should have significant projective and affine distortion for you to visually see the corrections.

2.4 Notes

1. You can find the provided images on the course website [I]. Note that the image named "wideangle.jpg" is obtained using a wide-angle camera. It contains a distortion called wide-angle or barrel distortion. The reason for including this image in the homework is just to show that there may be different types of distortions and the world of computer vision is really vast. Only removing affine distortion from this image may not be enough for this image.

2. You can use any image editor such as GIMP to determine the pixel coordinate values in the image.

3. You can use the OpenCV C++/Python libraries to handle low-level image and matrix operations. However you cannot use the built-in opencv functions such as findHomography or warpPerspective.

2.5 Submission

1. Turn in a typed pdf of your report via Blackboard.

2. Your pdf must include a description of

   - The logic that you used to solve the given Tasks.
   - The steps that you used for each of the Tasks with relevant equations
   - The input and output images for each task. **Illustrate clearly the parallel / orthogonal lines that you chose in the input image**.
   - Your source code.
   - Your observations on the relative performance of the two methods.

3. You are permitted to look at sample solutions from previous years to get an understanding of how to solve the problems. **Your final report must be your own.**

References
[**I**] http://web.ics.purdue.edu/~sakbar/ECE661/