CSE/ECE 344/544: Computer Vision
Assignment-4

Max Marks: 50 + 10(bonus) Due Date:

Instructions

- Please complete all questions.
- Keep collaborations at high level discussions. Copying/Plagiarism will be dealt with strictly.
- Start early, solve the problems yourself. Some of these questions may be asked in Quiz/Exams.
- Submission: Report all your results in a single pdf, put your report and code in a single zip folder and submit it on backpack.
- Late submission penalty: 25% credit per day.

1. (15 points) Load data *q1data.mat*. It contain end points of a set of lines. Plot lines as shown in the figure 1. Consider following four projective mappings.

$$H_1 = \begin{pmatrix} \sqrt{3} & -1 & 1 \\ 1 & \sqrt{3} & 1 \\ 0 & 0 & 2 \end{pmatrix}, H_2 = \begin{pmatrix} 1 & -1 & 1 \\ 1 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}, H_3 = \begin{pmatrix} 1 & 1 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 1 \end{pmatrix}, H_4 = \begin{pmatrix} \sqrt{3} & -1 & 1 \\ 1 & \sqrt{3} & 1 \\ 1/4 & 1/2 & 2 \end{pmatrix}$$

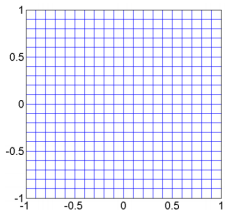

Figure 1: Lines

(a) (5 points) Apply these transformations (H_1, H_2, H_3 and H_4) and plot transformed lines in each case. Also, report transformed end points in your report for each case.

(b) (6 points) Which of the four transformations preserve following properties and why?

- length between points.
- angle between lines.
- maps parallel lines to parallel lines.

(c) (4 points) Categorize these transformations into euclidean, similarity, affine and projective transformations. We can write a transformation as a product of similarity H_s, affine H_a and projective transformations H_p. i.e $H = H_s{*}H_a{*}H_p$. Decompose H_4 into similarity H_s, affine H_a and projective transformations H_p.

2. (20 points) Suppose you have distorted images as shown in figure 2(left) and 3(left). Distorted images are given in the data folder. **Hint:** Refer (HZ section 2.7).
   (a) (4 points) Write mathematical formulation to remove affine distortion.
   (b) (6 points) Write code to perform affine rectification. (Comment code properly).
   (c) (4 points) Given the previous affine rectified image, write mathematical formulation to perform metric rectification.
   (d) (6 points) Write code to perform metric rectification. (Comment code properly).
   (e) (10 points) (**bonus**) Can we perform metric rectification in a single step i.e without performing affine rectification step?. If so, write its mathematical formation along with code with proper comments. Compare results with the above two step metric rectification.

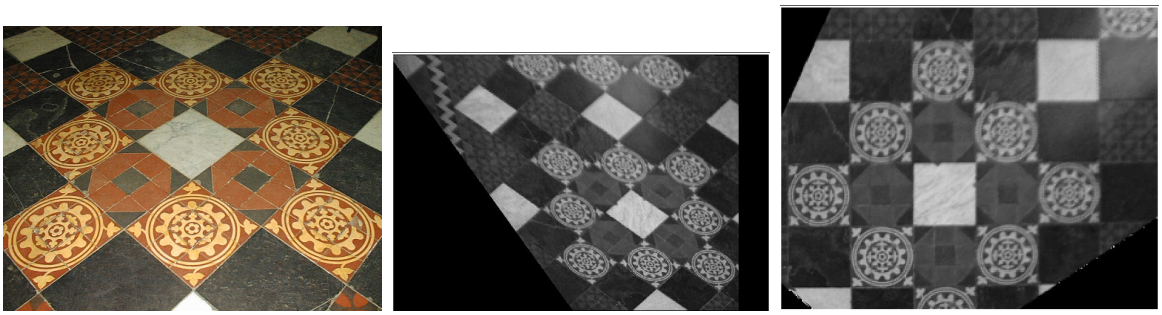

Figure 2: **Floor:** (left) Distorted Image, (middle) affine rectification, (right) affine+metric rectification

Figure 3: **Hall:** (left) Distorted Image, (middle) affine rectification, (right) affine+metric rectification

3. (15 points) Extract images from *q4data.zip*.

   (a) (3 points) Compute SIFT features for *image*1.*jpg* and *image*2.*jpg*. Based on the matching scores select top-500 feature matches. Plot putative feature matches.

   (b) (7 points) With these feature matches estimate an accurate homography mapping between *image*1 and *image*2. You might need to use RANSAC for accurate homography estimation.

   (c) (5 points) Warp *image*1 onto *image*2 using estimated homography. Create a new image that holds the warped image.