Multiple View Geometry: Exercise Sheet 7

Exercise: 12 July 2011

Part I: Theory

The following exercises should be **solved at home**. You do not have to hand in your solutions, however, writing it down will help you present your answer during the tutorials.

1. Suppose p_1, p_2 are two points on the line L, and L_1, L_2 are two lines intersecting the point p. Let x, x_1, x_2 be the images of the points p, p_1, p_2, respectively, and let l, l_1, l_2 be the coimages of the lines L, L_1, L_2, respectively.

   (a) Show that
   $$l \sim \hat{x_1} x_2, \qquad x \sim \hat{l_1} l_2,$$
   where $\sim$ means equivalence in the sense of homogeneous coordinates.

   (b) Show that for some $r, s, u, v \in \mathbb{R}^3$,
   $$l_1 \sim \hat{x} u, \qquad l_2 \sim \hat{x} v, \qquad x_1 \sim \hat{l} r, \qquad x_2 \sim \hat{l} s$$

   (c) Draw a picture and convince yourself of the above relationships.

2. Let x_1 and x_2 be two image points with projection matrices Π_1, Π_2. Show that the rank constraint
   $$rank \begin{pmatrix} \hat{x_1}\Pi_1 \\ \hat{x_2}\Pi_2 \end{pmatrix} \leqq 3$$
   ensures that x_1 and x_2 are images of the same three-dimensional point.

Part II: Practical Exercises

This exercise is to be solved **during the tutorial**.

1. Download the package `mvg_ex07.tgz` from the website. Extract the images `batinria0.pgm` and `batinria1.pgm`. Their corresponding camera calibration matrices can be found in the file `calibration.txt`.

2. Show the two images with matlab and select a point in the first image. You can use the command `[x,y]=ginput(n)` to retrieve the image coordinates of a mouse click.

3. Think about where the corresponding epipolar line L_2 in the second image could be.

4. Now compute the epipolar line $L_2 = Fx_1$ in the second image corresponding to the point x_1 in the first image. To this end you will need to compute the fundamental matrix F between the two images. (Use the calibration data from the file `calibration.txt`.)

5. Test your program for different points x_1. What do you observe?

6. If you have time left, determine the best matching point on the epipolar line via normalized cross correlation.

Matlab-Tutorials:

http://www.math.utah.edu/lab/ms/matlab/matlab.html
http://www.math.ufl.edu/help/matlab-tutorial/
http://www.glue.umd.edu/~nsw/ench250/matlab.htm