ECE 661 Homework 8

Due: 11/20/2008 Thursday (before the class)

This homework requires you to implement Zhengyou Zhang's camera calibration procedure.

Let's say you want to calibrate a camera at home or in your lab. You'd like to find all five of its intrinsic parameters and also find its six extrinsic parameters with respect to some world reference. Toward that end, mount the provided calibration pattern on a wall somewhere and do the following for acquiring the images you need for the camera calibration procedure:

1. Place the camera at a marked location on a table or a tripod and record an image of the calibration pattern. Feel free to use the calibrate pattern at 'http://web.ics.purdue.edu/~kim497/ece661/homework.htm'. The extrinsic pose parameters you will calculate will be for this location of the camera.

2. Now move the camera and rotate it so that it assumes different orientations vis-a-vis the calibration pattern. Record an image of the calibration pattern for each position/orientation of the camera.

Implement the following steps for extracting corners in each image:

1. Apply the Canny edge detector to the images.

2. Use the Hough transform to fit straight lines to the Canny edges.

3. Define the corners as the intersections of the fitted straight lines.

For these three steps, you can use the function 'cvCanny' and 'cvHoughLines2' from openCV library to find edges and fit straight lines.

Show the extracted the corner points from each image as in Homework 2. Assign and display integer labels given to the corner points; the corresponding corner points in all the images should get the same integer label.

Now compute the intrinsic and the extrinsic parameters by applying the non-linear optimization (gradient descent, Gauss-Newton, Levenberg-Marquardt) discussed in Section 3.2 of Zhang's report.

For even more credit, include radial-distortion correction parameters in your calibration procedure, as discussed in Section 3.3 of the report.

Finally, demonstrate the accuracy of the estimated calibration parameters by projecting the corner points in the calibration pattern into the image plane for one or more of the camera views. By visually comparing the locations of the projected corner points vis-a-vis their actual placements, one can ascertain the accuracy of a calibration procedure.

Notes.

- Clearly identify the steps you have taken to solve the problem with your own words.

- Your grade depends on the completeness and clarity of your work as well as the result.