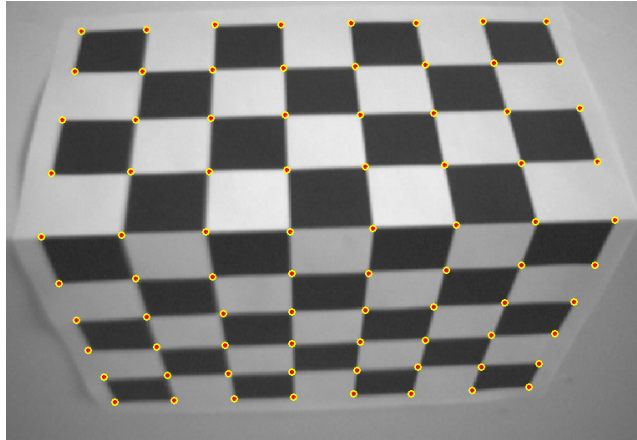


CSE 398/498-010

Real-time Image Processing for Autonomous Robot Systems

Laboratory 5: Camera Calibration

Report Due Date: 21 Oct 04



**A. Objective:** Recover the projection matrix  $M$  for an iSight camera through camera calibration techniques.

**B. Lab Procedure:**

1. Download and print out the calibration target from [http://www.vision.caltech.edu/bouguetj/calib\\_doc/htmls/pattern.pdf](http://www.vision.caltech.edu/bouguetj/calib_doc/htmls/pattern.pdf)
2. Mount the target so that it forms an orthogonal basis
3. Take several pictures of the calibration target using your specific iSight camera. At a minimum, this should include one view where the target subtends most of the image field of view (as above).
4. Note the camera specifications ( $f$ , CCD size, etc.).

**C. Report Requirements:**

1. Measure your target to establish the world frame coordinates for the target corners.
2. Using Matlab, establish a set of world/image correspondences.
3. Recover the scaled projection matrix  $M'$
4. Recover the true projection matrix
5. Decompose this into intrinsic and extrinsic parameters
6. Refine your estimate for the rotation matrix  $R'$  by enforcing orthogonality constraints through another SVD decomposition of  $R'$
7. Compare the values you obtain from using small (6) and large sets of correspondences.

8. Compare the values you obtain from choosing the origin in the upper left corner of the target vs. the center of the target.
9. In some cameras, the effective horizontal and vertical pixel sizes are different. The relationship  $\alpha = s_x / s_y$  is denoted as the *aspect ratio*.  
What is your estimate of the aspect ratio for the iSight?
10. How does your estimate for the focal length compare with that recorded above?

**D. Some Potentially Helpful Matlab Functions:**

1. `ginput`
2. `reshape`
3. `norm`
4. `SVD`

**E. Turn in:**

1. Your Matlab source code.
2. A printout of your final Matlab session showing the steps for used to decompose the projection matrix  $M$  into intrinsic and extrinsic parameters.
3. A write up reflecting the procedure and questions in part B/C.