

AP 187 Activity 11

Camera Calibration

Introduction

Please go through the Camera Calibration.pdf lecture.

Materials

Raspi and PiCam, camera stand, Lightbox, stiff board, paper and printer, ruler, any imaging software, scientific software.

Procedure

1. For this experiment we need to use a camera that has minimal distortion. To check, capture a scene with straight lines such as floor tiles, checkerboard patterns or graphing paper. If straight lines do not look straight (i.e., there is barrel or pincushion distortion), use another camera. Or, if the camera is able, set it to normal (like GoPro is by default wide angle but it can be set to a “Normal” view).
2. Create a 3D calibration checkerboard (known as Tsai grid). You can print a checkerboard pattern and paste it onto a right-angled surface.
3. Take two images of the checkerboard with your camera. For the second image move the camera a little off-set from the position of the first. We will use the second image later but for now we will use only one of them.
4. Pick an origin and a right-handed coordinate system in the Tsai grid and tabulate the physical coordinates of around 11 to 25 or more corners of the squares of the checkerboard pattern. NOTE: Each corner point will have an $[X_g, Y_g, Z_g]^T$ coordinate.
5. Open the Tsai grid image using GIMP or Paint and tabulate the $[x_i, y_i]^T$ coordinates of your calibration points in image space.
6. Using all the points you've selected, set up matrices **Q** and **p** in Equation 31 of the lecture notes. Compute the elements of the calibration matrix **a** using Equation 33.
7. To verify if you got the calibration correctly, predict the image coordinates of some cornerpoints of the checkerboard which were not used in the calibration. Overlay the predicted cornerpoints on the image. Comment on the accuracy of your prediction.