

In this lab, you will use MATLAB's built-in edge detection, corner detection and Hough line extraction functions to get the coordinates of the corner points of checkerboard stuck to a cube for camera calibration purposes.

Important Note: You should complete the lab until the end of the lab hours and submit all your codes to SUCourse as a single zip file. Deadline for in-lab code submission to SUCourse is **15:30**.

Things to do:

Write a program ("lab5calibprep.m") to detect corner points with **two** different methods:

1. Harris corners (integer pixel accuracy)
2. Intersection point of two Hough lines (sub-pixel accuracy)

Implement the following steps:

- Read the image of the calibration cube given in SUCourse (Figure 1(a)) and convert it into a black-white edge image with an edge detector of your choice.

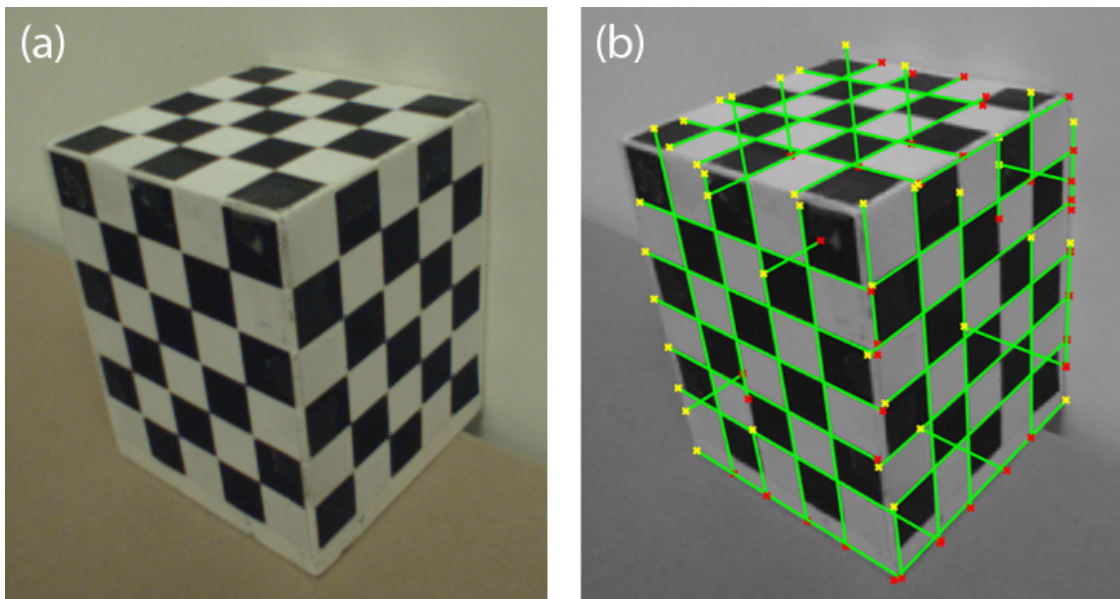


Figure 1: (a) Calibration object (b) Result of Hough line detection.

- Find the lines in the edge image by utilizing the built-in 'hough', 'houghpeaks' and 'houghlines' functions with the appropriate parameters.
- Plot the lines, their start and end points on the gray-scale version of the original image with green, yellow and red colors respectively (Figure 1(b)).
- Select two intersecting lines manually from the plot that you have obtained in the previous step and extract the corresponding ρ and θ values from the output of 'houghlines' function.

- Establish the equations of these two lines by using the line equation given below and plot the lines with magenta color on the same figure:

$$x \cos(\theta) + y \sin(\theta) = \rho \quad (1)$$

- Find the intersection point of those two lines with sub-pixel accuracy by solving the system of equations given below for x and y and plot that point on the same figure:

$$x \cos(\theta_1) + y \sin(\theta_1) = \rho_1 \quad (2)$$

$$x \cos(\theta_2) + y \sin(\theta_2) = \rho_2 \quad (3)$$

- Using the gray-scale version of the original image, find the Harris corners and plot them on the same figure with blue circles (Figure 2).
- Calculate and display the distance between the two corner points that you obtained with two different methods.

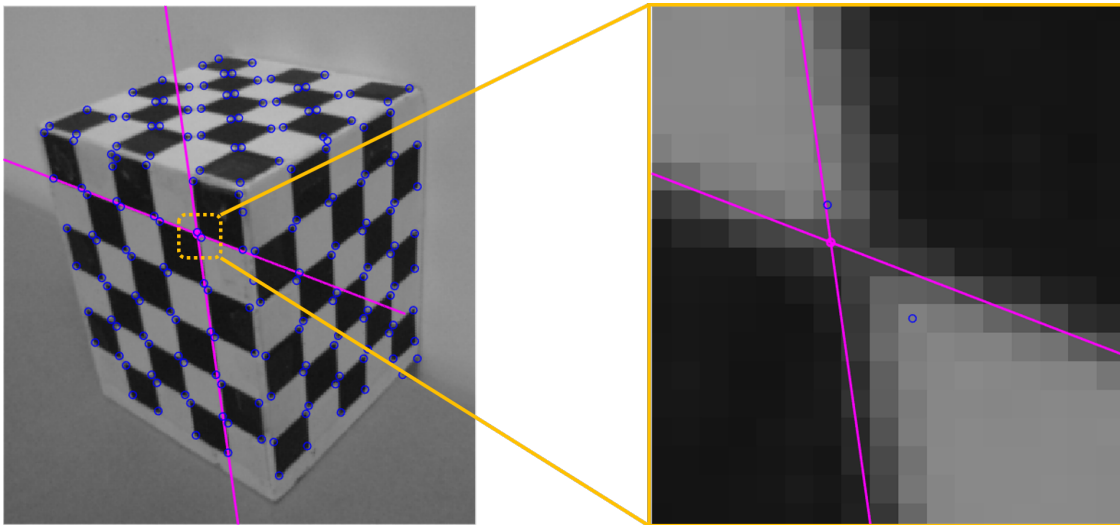


Figure 2: Corners extracted by the intersection point of two lines and Harris corner detection algorithm.

Post Lab

Create your own 3D calibration object, take a picture of it and extract at least 8 corner points by following the steps above. Provide the resulting image with the extracted lines and corner points displayed on it, in addition to providing the obtained equations. Discuss your results. Which corner extraction method would you prefer for calibration purposes? Can you suggest better methods?

Deadline for post lab report submission to SUCourse: **21 November 2022, 23:55.**