

International Institute of Information Technology, Hyderabad
CS7.505: Computer Vision
Assignment 1: Camera Calibration

Instructions:

- The goal of the assignment is for you to get familiarized with the process of camera calibration and the critical role it plays in using any measurements of the world from images.
- You need to upload a single pdf file containing 1) your report 2) your code that you wrote and 3) the output images with overlays of models. The file should be uploaded in the moodle portal.
- Include the assignment number, your name and roll number at the top-right of the first page of your submission (pdf).
- **Make sure that the assignment that you submit is your own work. Any breach of this rule could result in serious actions including an F grade in the course.**
- The experiments and report writing takes time. Start your work early and do not wait till the deadline.

Submission: Any time before *Thursday, 27th Jan 2022, 11:00PM*

1 Summary

This assignment requires you to implement and compare the two camera calibration techniques. We would also like to test the quality of the parameters estimated from these calibration methods. You are expected to do the following:

1. Implement the DLT (Direct Linear Transformation) based calibration that we discussed in the class. You could use C/C++, Python or Matlab for this. However, you are expected to implement it yourselves and not use an existing implementation.
2. Implement the RANSAC based variant of the calibration that we discussed in the class. Note that these two algorithms use a set of known correspondences between real-world points and image points.
3. Use the image that is provided along with this assignment along with the real-world measurements that are given to you to compute the camera's internal and external parameters using each of the above algorithms. Note that you need to manually estimate the image co-ordinates of the given world points. You may implement and use the Harris Corner detector to help select these points. Describe your observations regarding the results.
4. Repeat the above experiments after correcting for radial distortion. Estimate the radial distortion parameters from the straight lines in the image. What do you observe regarding the resulting parameters?
5. Use the real-world measurements that are provided along with the estimated camera parameters to compute the image of a wireframe of the object. Note that you will be computing the location of image points as $x_i = P.X_i$, and not use the image points. Overlay (draw) the wireframe over the actual image of the object using straight lines between the computed points x_i . What do you observe about the overlay?
6. Repeat the calibration of the camera using Zhang's method using either the available OpenCV or Matlab implementation. How does your results compare with DLT based method?
7. Repeat the overlay of wireframe using the internal parameters estimated from Zhang's method. Describe your observations.
8. What is the image of the world origin, given the calibration matrix? Does this result bear out in your observations?

9. Select a camera that you would like to use for the assignments. Note that you might be using this camera for future assignments also. This could be your laptop camera, mobile phone camera or any other digital camera that you have access to.
10. Repeat the 3 calibration methods using your own camera and your own calibration object for which you measure and determine the world co-ordinates. Use a printed checkerboard pattern for Zhang's method. Describe and comment on the results of each method.

Write a detailed report of your findings and results as mentioned in the previous steps, and submit it as a pdf file. You should also include your code and images that you acquired for the experiments at the end of the pdf file that.

2 Submission

Submit a report as a single pdf file as mentioned at the top. Submit the file in the moodle portal before the deadline (11PM on Thursday, 27th January). The report should contain:

- A description of the problem, algorithms, results and comparison of the calibration methods based on the experiments you performed.
- Challenges you faces and learnings from the experiments.
- Images of the inputs and outputs for the different algorithms and cameras.
- Code for calibration that you wrote.

You are expected to write the complete code for the assignment yourselves. DO NOT COPY ANY PART FROM ANY SOURCE including your friends, seniors or the internet.