

Q1) **Hough Transform:** In this question, you are required to detect the circles in a given image. Your program should convert the image into grayscale, apply Gaussian blurring to it and then estimate and mark the positions of the circles present in it. The estimation of circles should be done through Hough Transform implemented from scratch in Python only. Usage of OpenCV for Hough Transform is prohibited. The report must contain the following: **[50 Marks]**

1. All the intermediate images generated in the process
2. 5-10 lines detailing the process you followed and the edge detection method
3. A final image containing the detected circles

Your implementation must be generic so that it may work on any given image. During test time, a new image will be provided for evaluating the correctness of the implementation.

Q2) **Camera Calibration:** Recall the significance of different camera matrices and parameters in Lecture 9. In this question, you have to estimate all of the camera matrix parameters from a set of images using OpenCV and Python only. The images can be found [here](#). Use all the images to get an estimate of the camera parameters. Mention the following in the report: **[50 Marks]**

1. Intrinsic parameters - focal length, skew and the principal point
2. Extrinsic parameters - rotation and translation
3. Distortion coefficients
4. Using extrinsic and intrinsic parameters compute the re-projection error of the images selected and the mean reprojection error

Q3) **Corner Detection:** In this question, you will be implementing corner detection of an image by implementing the Harris corner detector. The images can be found [here](#). Implement the Harris corner detector from scratch. You can use numpy libraries for basic operations. Show the comparative study by considering any three threshold value $[-4.00, -2.00]$ (log10 scale). To run the detector use Gaussian kernel of width 7 pixels and standard deviation 1.5. **[30 Marks]**

Pick any one of the images and perform the following operations.

What effect detector will have if we perform the following operations on the input image

- a) Rotate the image clockwise 90 degrees. **[10 Marks]**
- b) Compress the image by a factor of 2. **[10 Marks]**

Write down your observations and visualize results of all experiments.

[Report + Viva : 25+25]

Submission Policy and Requirements

1. Any kind of plagiarism is not accepted. We will strictly follow institute policies for plagiarism.
2. Please keep the discussion on the abstract level.
3. Recommended programming languages:python+opencv.