

Introduction to Computer Vision

Assignment #1: Camera Calibration

Deadline: 2025.10.02

Objective

In this assignment, you will perform **camera calibration** using your own captured checkerboard images. You will (1) implement **Zhang's method** from scratch, and (2) apply **OpenCV's built-in calibration function**, then compare the two results.

Tasks

1. Data Collection

- Print the provided checkerboard pattern (Checkerboard-A4-20mm-13x9.pdf).
 - The checkerboard has a square size of 2 cm, and you must print it at the actual scale (no resizing or scaling) so that the corresponding 3D data for calibration can be easily obtained.
- Using your camera, capture at least **10 images** of the checkerboard from different orientations, distances, and viewing angles.
- When capturing the checkerboard with your camera, make sure the checkerboard is clearly visible and covers different parts of the image.

2. Implementation (Zhang's Method)

- Implement Zhang's method using your captured images.
- Steps should include:
 - Estimating homographies from checkerboard corners.
 - Computing the intrinsic matrix (f_x , f_y , c_x , c_y).
 - Estimating extrinsic parameters (R , t) for each image.
- Optional: Non-linear refinement by minimizing the reprojection error.

3. OpenCV Calibration

- Use `cv2.calibrateCamera()` with the same images.
- Obtain intrinsic, extrinsic, and distortion parameters.

4. Comparison & Analysis

- Compare your implementation results with OpenCV's results.
- Report the differences in intrinsic parameters and reprojection error.
- Provide visualizations (e.g., undistorted image, reprojection of checkerboard corners).
- Briefly explain possible reasons for discrepancies.

Submission

- **Report (PDF):**
 - Description of implementation steps.
 - Intrinsic and extrinsic parameters from both methods.
 - Reprojection error comparison.
 - Example visualizations (checkerboard corners, undistorted images).
 - Short analysis of results and difficulties encountered.
- **Code:** Submit your source code (Python preferred).

Grading

- Zhang's method implementation (30%)
- OpenCV calibration results (20%)
- Comparison and analysis (30%)
- Report clarity and code quality (20%)

