Bauhaus-
Universität
Weimar

Photogrammetric Computer Vision WiSe2024

Assignment 3

Group 30

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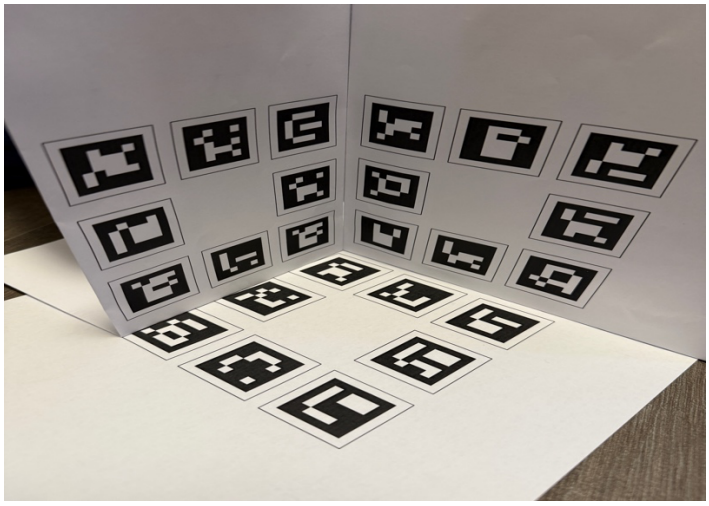
Camera calibration using a direct linear transformation (DLT)

1.Image acquisition: -

a) Acquired calibration: - In this assignment we used the 3D coordinates inside the shoe box, and we marked 2 points in each coordinates (total 6 points).



b) **Technical information of camera**: - We used camera of a smartphone.

Dimensions: 5712 × 4284 Pixels
Size: 2.8 MB
Path: IMG_1201
Device: Apple iPhone 16 Pro
Focal Length: 24 mm
Aperture: f/1.78
ISO: 80
Flash: Not Fired
White Balance: Auto
Exposure Time: 1/813 s

2) Control point measurements: -

a) Define axes of object coordinate system: - we used Right hand thumb rule for defining the axes of object coordinates system.

b) Points on object coordinate: - we measured the points on object coordinates with the prerecession of 1 mm.

4) Interpretation of the projection matrix: -

a) Meaning of extracted parameters: -

• Projection matrix: - It is the matrix which shows transformation from 3D points to 2D points.

P =

0.0115	0.0200	-0.0132	-0.7081
-0.0173	0.0056	-0.0158	0.7052
-0.0000	0.0000	-0.0000	-0.0001

- **Intrinsic Matrix (K):**

1.0e+03 *

-0.2090	-1.3752	2.2235
0	1.7512	1.6118
0	0	0.0010

- **Rotation Matrix (R):**

-0.4302	0.5915	0.6819
-0.8986	-0.3531	-0.2606
-0.0866	0.7249	-0.6834

- **Camera Center (C):**

-12.5733
106.0821
96.0047

- **Rotation Angles (degrees):**

Omega (Roll): 133.3132
Phi (Pitch): 4.9695
Kappa (Yaw): -115.5856
Intrinsic Parameters:
Principal Distance (a_x): -208.9957
Skew Factor (s): -1375.2065
Principal Point (x_0, y_0): (2223.4873, 1611.7942)
Aspect Ratio (a_y / a_x): -8.3793
Reprojection Residuals:

1.0e+03 *

0.0244
0.0512
1.3592
0.0136
0.0040
0.3983

b) Comment on the entire calibration process:

Calibration, as explained in the lecture, refers to the estimation of intrinsic parameters. In this code, we began by initializing the object coordinates and capturing the image coordinates using an inbuilt function. The projection matrix was computed using Singular Value Decomposition (SVD). From the projection matrix, we derived the calibration and rotation matrices using the RQ decomposition theorem. These matrices allowed us to calculate all the necessary 11 parameters.
The quality of the calibration depends heavily on the sharpness of the captured image. Any movement during image capture introduces blur, which can negatively impact the results. Therefore, to ensure high-quality calibration, it is essential to hold the camera steady and avoid any vibrations during the capture process.