CV HW1 report

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Introduction

In this report we will show you the implementation of camera calibration in detail and compare the result of our implementation and the original openCV library's camera calibration method.

Image distortion

Some pinhole cameras will introduce distortion to images, and the distortion will let straight lines appear curved. Therefore we need to use camera calibration to slove this problem.

Implementation procedure

In the first place, we obtain n raw images taken a chessboard from different rotation and position as our input data, then we need to get object points,which is the 3d points chessboard corner in real world space, and image points, which is the 2d points chessboard corner in image plane from the images. Therefore we use openCV findChessboardCorners to get them.

Second, by getting the corner of 3d and 2d points we can find the H matrix, which is the Homography matrix of each image by using Singular Value Decomposition(svd). Each of H matrix is the multiplication of the intrinsic matrix, which includes information like focal length (f_x,f_y), optical centers (c_x, c_y) specific to a camera, and extrinsic matrix, which is corresponding to rotation and translation vectors which translates a coordinates of a 3D point to a coordinate system.

Third, we now have the H matrix, thus we can get a matrix B from H. Since B is positive definite, we can apply Cholesky decomposition to B, and get the intrinsic matrix.

Finally, we get the intrinsic matrix. Therefore, we can use the intrinsic matrix to find the extrinsic matrix of each image, and also get the rotation and position of each camera from it.

Experimental result(of course you should also try your own images)

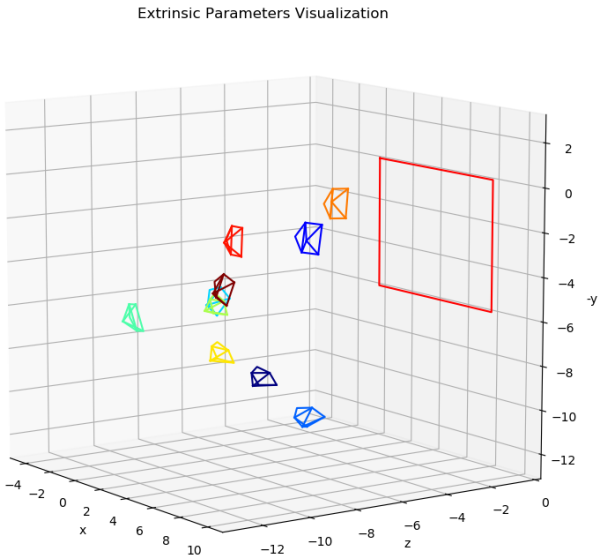
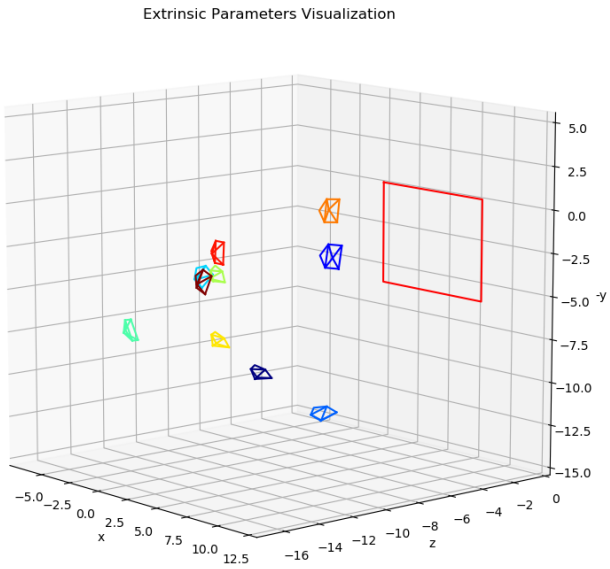
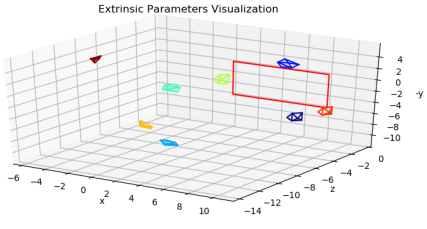
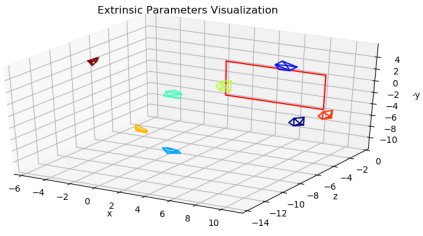
Result	openCV	our implementation
TA's data	 Intrinsic matrix of openCV's calibrateCamera [[3.17e+03, 0, 1.64e+03], [0, 3.19e+03, 1.43e+03], [0, 0, 1,]]	 Intrinsic matrix of our implementation [[3.17e+03, 0, 1.64e+03], [0, 3.19e+03, 1.43e+03], [0, 0, 1,]]
Our data	 Intrinsic matrix of openCV's calibrateCamera [[3.62e+03, 0, 2.27e+03], [0, 3.63e+03, 1.29e+03], [0, 0, 1,]]	 Intrinsic matrix of our implementation [[3.62e+03, 0, 2.27e+03], [0, 3.63e+03, 1.29e+03], [0, 0, 1,]]

Table 1: The compare of our experimental result and openCV's calibrateCamera.

Our images source

Discussion

We present camera calibration, it can estimate the parameters of a lens and image sensor of an

image. We showed that our result is same as openCV's calibrateCamera, and get the same intrinsic matrix and extrinsic matrixs. Therefore, have the same extrinsic matrixs, we can get the same camera position and rotation. You can also see that in the Table 1, we get the same result image from both of our testing data and TA's data.

Conclusion

In this report we give a simple introduction of camera calibration and the implementation procedure in detail. In the experiment results, it shows that there are no differences between our result and openCV's calibrateCamera.

Work assignment plan between team members.

- main code 吳承翰
- testing result 謝宗祐
- report 謝秉瑾