

Computer Vision

Assignment 2

The aim of the assignment is to calibrate a camera using point matches of images and objects. The assignment requires us to calculate the Camera Projection Matrix using three different but related methods. The fourth method requires one to calculate the Projection Matrix using the in-built functions present in OpenCV.

The output errors for the images using various methods is shown:

The errors for image 0

The mean projection error with only 6 points is 36.5822

The mean projection error with all points using SVD is 1.39394

The mean projection error using RANSAC method is 3.13796

The mean projection error using the built initCamera and SolvePnP is 51.0511

The errors for image 1

The mean projection error with only 6 points is 2.16994

The mean projection error with all points using SVD is 0.99848

The mean projection error using RANSAC method is 1.29354

The mean projection error using the built initCamera and SolvePnP is 67.1587

The errors for image 2

The mean projection error with only 6 points is 6.003

The mean projection error with all points using SVD is 1.03488

The mean projection error using RANSAC method is 1.42493

The mean projection error using the built initCamera and SolvePnP is 43.3734

The errors for image 3

The mean projection error with only 6 points is 1.97569

The mean projection error with all points using SVD is 1.26003

The mean projection error using RANSAC method is 1.10131

The mean projection error using the built initCamera and SolvePnP is 34.5712

The errors for image 4

The mean projection error with only 6 points is 4.06175

The mean projection error with all points using SVD is 1.14335

The mean projection error using RANSAC method is 1.51269

The mean projection error using the built initCamera and SolvePnP is 77.1511

The errors for image 5

The mean projection error with only 6 points is 12.7077

The mean projection error with all points using SVD is 0.998794

The mean projection error using RANSAC method is 1.23645
The mean projection error using the built initCamera and SolvePnP is 38.1718

The errors for image 6
The mean projection error with only 6 points is 27.4596
The mean projection error with all points using SVD is 1.44833
The mean projection error using RANSAC method is 2.13533
The mean projection error using the built initCamera and SolvePnP is 35.9127

The errors for image 7
The mean projection error with only 6 points is 13.3401
The mean projection error with all points using SVD is 1.55374
The mean projection error using RANSAC method is 1.76525
The mean projection error using the built initCamera and SolvePnP is 30.999

The errors for image 8
The mean projection error with only 6 points is 4.41648
The mean projection error with all points using SVD is 0.795849
The mean projection error using RANSAC method is 1.61238
The mean projection error using the built initCamera and SolvePnP is 13.4428

The first method is the DLT method or Direct Linear Transformation uses 6 points and linearly solving the equation $A \cdot P = 0$ where A is a matrix constructed from image and world co-ordinates. The function used is solveZ from OpenCV. The six points were randomly selected.

As can be seen from the output, the error depends a lot on the random points selected and hence is not very reliable.

The second method is LSE using SVD decomposition. The procedure is same as the above except all the point matches in the dataset are used. It can be seen that the error is relatively small since the model tries best to fit all possible points. It can be seen that the error is roughly constant across all images.

The third method used is RANSAC method (Random Sample Consensus). The model uses the first method (DLT) in deciding to find the best fitting solution for some number of iterations. The model that gives the best results is taken as the Projection Matrix. For the above output threshold is taken as 1 and probability of choosing an inlier from a random sample of 6 is taken as 0.9. The method is as good as SVD and may be sometimes even better as seen from output.

The last method uses built in initCamera2d and solvePnP functions. Surprisingly the errors are very much and the reason may be because of the algorithms used and conversions between matrices involved which effect the data in them.