What Is Camera Calibration?

Geometric camera calibration, also referred to as *camera resectioning*, estimates the parameters of a lens and image sensor of an image or video camera. We can use these parameters to correct for lens distortion, measure the size of an object in world units, or determine the location of the camera in the scene. These tasks are used in applications such as machine vision to detect and measure objects. They are also used in robotics, for navigation systems, and 3-D scene reconstruction. To estimate the camera parameters(which include intrinsics, extrinsics, and distortion coefficients), you need to have 3-D world points and their corresponding 2-D image points.

How Do We Perform Camera Calibration?

1- First, we are looking to select a pattern where we can easily extract high-quality feature points. In order to do this, we most commonly use chessboard patterns (The reason for this is that chessboard pattern corners are simple to detect and invariant to lens distortion). We also have to make sure that the pattern is mounted onto a rigid flat surface.

2- Next, we have to take many pictures of the target at different orientations and distances, In order for our lens to “see” the different possibilities. We select the portion of these pictures where the pattern is focused On

3- Finally, we extract the feature points from the selected images, using an algorithm such as SIFT or SURF, and then compute the parameters using those found feature points.

In order to perform this final step, we can also make use of external software which implement their own high performance feature detection algorithm. In this article we will be looking at how Matlab can be used in order to perform this task.

Stereo Camera Calibration

Stereo Camera calibration is largely similar to single camera calibration, A stereo system consists of two cameras: camera 1 and camera 2. After calibrating a stereo system, we can then use the stereo parameters in order to find depth in images.

With Stereo Camera Calibration, we perform the same steps as previously mentioned, with the only difference being that we take multiple picture pairs (pictures taken at roughly the same time by the two cameras), and then after making sure the chessboard is visible and being focused on for both images in each pair, we then input those image pairs into the feature detector.

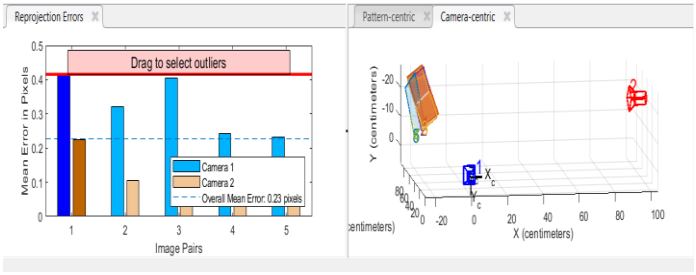
The Stereo calibration setup I used is as follows:

Stereo Calibration using Matlab

In Matlab, We can use the Stereo Camera Calibrator app to calibrate a stereo camera. The workflow is as follows:

Some of the Images pairs I used for camera calibration is as follows:

After Performing calibration on five image pairs, the following results were obtained:



Which shows the overall Mean error as 0.23, which could have been greatly reduced if I had given more variation to the chessboard's position, and inputted more pairs.

After performing calibration, we are given the option to export the stereo calibration parameters in order to use them:

And by doing so, A StereoParameters variable is stored in our workspace. We can also save this parameters variable into a file, so that we can make use of the values for future sessions.