

# METR4202: Advanced Robotics and Control

## Tutorial 7: Image Calibration

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Last week's tutorial demonstrated several basic computer vision techniques important to robotics. Although you may not realise it, all real-world cameras distort straight lines. This distortion degrades the performance of subsequent computer vision operations.

In this tutorial we will introduce you to camera calibration and image rectification using Matlab.

### 1 Reading and Background

Read section 11.2 (Camera Calibration) from Corke.

Install the Bouguet Camera Calibration Toolbox from [here](#), then review the documentation on the website.

Download and watch the 'calibration\_dance.avi' video. Then download the 'calibration\_dance.mat' file from the course website. This matlab file contains 100 rgb+d frames from the video. The rgb frames are saved as a 480x640x3x100 double matrix and the depth frames are saved as a 480x640x100 double matrix.

Load this file in matlab and display one or two of the frames.

### 2 Image Extraction

It would be possible to run the Calibration toolbox on all 100 frames, however the toolbox only needs 20 frames to accurately recover the camera calibration parameters. Using more frames will only take longer, and will not give much improvement in the calibration results.

Write a matlab function `choose_n_images(rgb_images, n)` that will randomly pick n rgb frames from the video, and save them in the .JPG format to the current directory.

### 3 Calibration

Run the `calib` command to start the calibration toolbox.

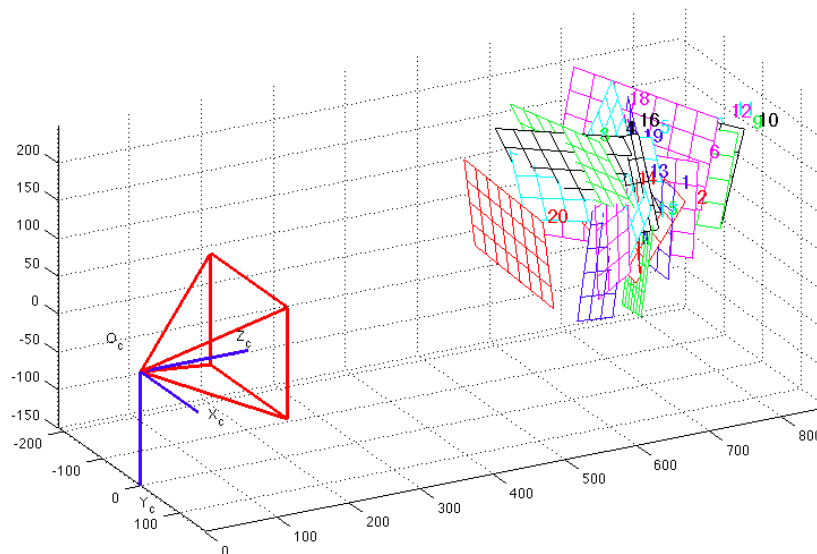


Use the toolbox to perform camera calibration using your images from the previous question (the chess board squares in the video are approx. 30x30mm).

What is this Kinect's intrinsic parameter matrix?

What is the % error (x and y) in the focal length? Re-run the calibration using all 100 frames. Does the % error change?

Try the other features 'Reproject on images' and 'Show Extrinsic'.



## 4 Undistortion

After calibration, the intrinsic parameter matrix can be used to undistort images taken with the same camera. Many computer vision techniques work much better when using undistorted images, hence the need for calibration. Undistort the images you used for the calibration and compare with the originals.

In a few words, describe the distortion caused by the Kinect's rgb lens.