# METR4202 – Robotics & Automation

**Lab/Prac 6:** Camera Calibration & Homography                    (by: .A Snoswell & S.Singh)

**Reading**
Please read/review Lecture 7 -- Robot Sensing: Single and Multiple View Geometry
See also §11.2 (Calibration) in RVC.

This tutorial will introduce the basics of camera calibration in Matlab.  Please review Matlab's for any commands in this tutorial that you do not recognize – `doc <command>` is very helpful!

## 0 Download the Toolbox & Load Images

Install the Bouguet Camera Calibration Toolbox from class's Software page.
[`http://robotics.itee.uq.edu.au/~metr4202/software/index.html`]

From the course website please download the `calibration_dance.avi` video and the `calibration_dance.mat` file.  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.

## 1 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.

**� Questions �**
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 JPEG format to the current directory.

## 2 Running the Calibration Toolbox

Please run the `calib` command to start the calibration toolbox.
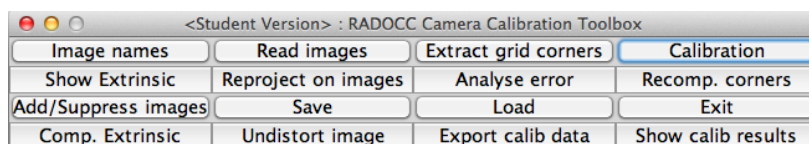


Use the toolbox to perform camera calibration using your images from the previous section. (the chess board squares in the video are approx. `30x30mm`).

**� Questions �**
- What is this (Kinect Xbox 360) camera's intrinsic parameter matrix?
  What is the % error ($x$ and $y$) in the focal length?
- Now, re-run the calibration using all 100 frames.  Does the % error change?

## ◆ Challenge Questions ◆

- → Now bend the target and take your own images, how does the calibration change?
- → Now consider the <u>warped pattern</u> (at right) Should the calibration work? If so, will it change?
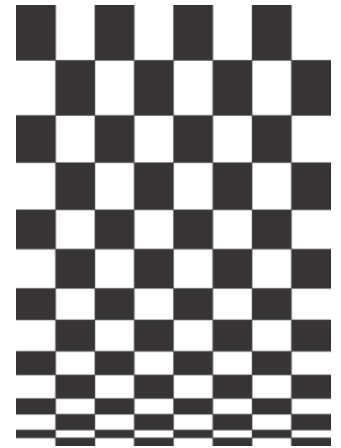
For fun, try some of other features such as `Reproject on images` and `Show Extrinsic` (see below) and <u>visualize_distortions</u>
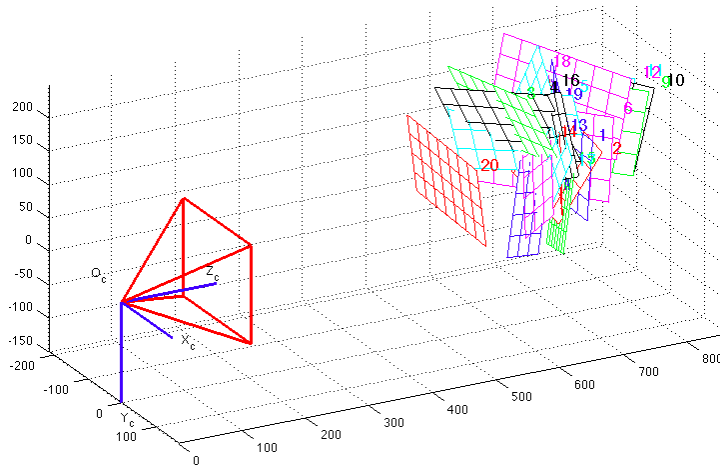


# 3 Homography

The calibration process can also help us with perspective transforms of the image.

For example, because you know the lines in the checkerboard pattern are parallel, it is possible to correct the perspective of the image so that the checkerboard squares are actually square.
(see also example below)

You may use checkerboard, `cpselect`, `cp2tfrom` and `imtransform` for this.