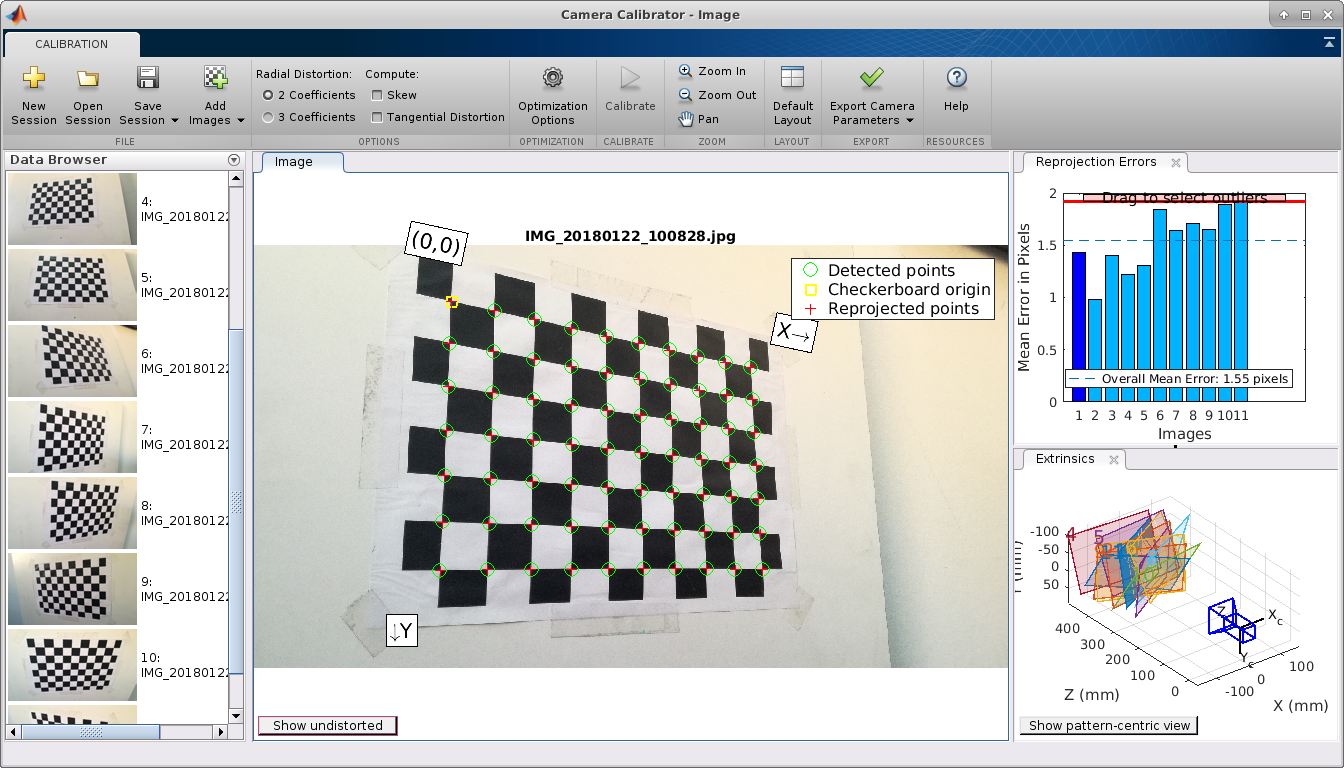
# COMPUTER VISION

**EXERCISE 9: Fundamental matrix**

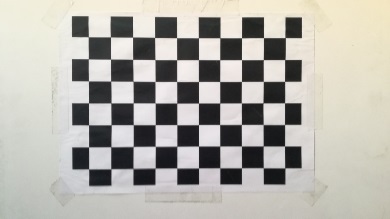
Concepts: Camera calibration, Harris operator, fundamental matrix, epipolar lines, stereo.

1. **Camera calibration.** Since we are almost experts in computer vision, we are going to calibrate the camera of our smartphone or laptop. For that we are going to use the amazing tutorial and calibration application from MATLAB. The tutorial is full of interesting information and directions about how to calibrate the camera properly, as well as how to interpret the obtained results. To calibrate the camera, you only need the provided application, a pattern with a chessboard, and the camera itself! Take different pictures of the chessboard with different perspectives, run the application, and enjoy!
   * Tutorial url: <https://es.mathworks.com/help/vision/ug/single-camera-calibrator-app.html>



*Matlab Camera Calibrator application after the calibration of a camera.*

* + If you find technical problems to calibrate the camera, report them in your report and use the provided images and camera parameters.

**  

*Example of images observing the calibration pattern from a smartphone.*

* + Recall that in this exercise we are interested in the intrinsic parameters **cx**, **cy**, and **f** (center of the image and focal length, all of them in pixels). Include them in your report, along with the resolution of your camera (if your camera has a high resolution, consider resizing all the images so Matlab doesn’t become too slow).

Once the camera is calibrated, take a pair of pictures from surfaces with visual features , and measure the distance that the camera moved between both shots. It will be our baseline **b**. *Note: 10cm or so is ok.*

*Example of three images with a planar surface (the cereal box), where the camera moved 5cm to the right from the image on the left to the one in the middle, and 10 cm to the one on the right.*

1. **Fundamental matrix.** Now run the Harris keypoint detector that we designed in a previous exercise, and match the obtained keypoints. Then compute the fundamental matrix using the provided function **ransacfitfundmatrix**. *Note: if you were unable to calibrate your camera use the pepsi\_left.tif and pepsi\_right.tif images.*
2. **Epipolar lines**. Next, using **ginput**, set any pixel on the left image and draw on the right one the corresponding epipolar line. ¿Where are the epipoles in each image?
3. **Tridimensional reconstruction.** Finally, project in 3D the matched points by cross correlation using the following equations, and represent them in a figure using **plot3**:

|  |
| --- |
| Xi = b\*(xli-cx)/di  Yi = b\*(yli-cy)/di  Zi = f\*b/di |

Use the parameters cx, cy, and f from your camera, and the baseline between the two pictures. If you are working with the provided ones (pepsi images), use the following ones:

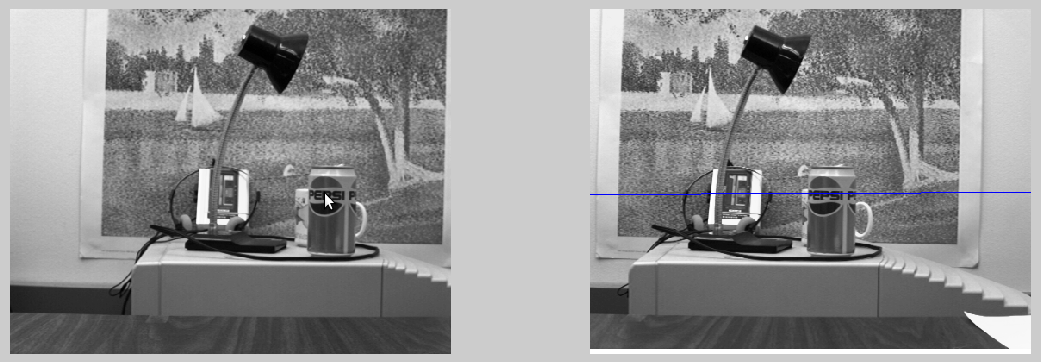
b = 0.119 m, cx = 255.64 px, cy = 201.12 px, f = 351.32 px, di= disparity of i-th point

**Commands:**

|  |  |
| --- | --- |
| **[F, inliers] = ransacfitfund matrix(x1,x2,1e-5);** | Computes the fundamental matrix from two sets of points matched using RANSAC. |
| **plot3(x,y,z)** | The same as plot, but in 3D. |
| **patch(x,y,z,c)** | Draws a 3D surface with color c=[r,g,b]. |

**Results**

*Epipolar lines*



*Projected points in 3D. Green Surface representing the poster.*

