

COMPUTER VISION

Assignment 1

Keio University



1 Camera calibration

Picture 1 was taken with the main rear camera of a Samsung Galaxy A70. Camera calibration was then applied to the image to obtain the intrinsic parameters of the camera. This process was performed with a code adapted from [2].

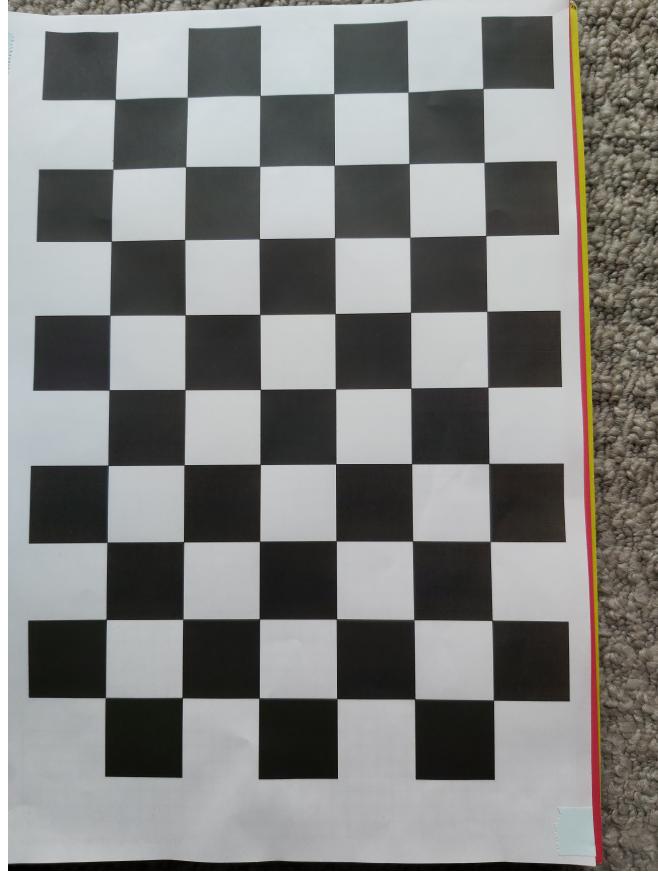


Figure 1: Chequerboard picture

All measures made on the image are expressed in pixels. The projection matrix \mathbf{P} found is:

$$\mathbf{P} = \begin{pmatrix} 3.89 \cdot 10^3 & 0 & 2.43 \cdot 10^3 \\ 0 & 3.91 \cdot 10^3 & 3.46 \cdot 10^3 \\ 0 & 0 & 1 \end{pmatrix}$$

The distortion parameters are:

$$\kappa_1 = 1.15 \cdot 10^{-1}$$

$$\kappa_2 = -3.08 \cdot 10^{-1}$$

$$\kappa_3 = 2.24 \cdot 10^{-1}$$

$$p_1 = -2.54 \cdot 10^{-5}$$

$$p_2 = 6.04 \cdot 10^{-4}$$

2 Camera focal length

The previous method returned 2 different measures for the focal length because the algorithm assumes a difference between horizontal and vertical measurements. Both focal lengths are quite close. The difference is most likely due to small errors or approximations in the algorithm. As such, the focal length is likely around $3.9 \cdot 10^3$ pixels. The camera focal length given by the manufacturer is 27 mm for a 35 mm film. The actual focal length is 3.9 mm [1].

The measures can be compared by converting the millimetre focal length into pixels. This can be done with the following equation[3]:

$$\text{focal length in pixels} = (\text{image width in pixels}) \cdot \frac{(\text{focal length in mm})}{(\text{sensor width in mm})}$$

The image width is known to be 4896 pixels and the sensor width is given by [1] as 5.2 mm. As such, the focal length in pixels is given by:

$$\text{focal length in pixels} = 4896 \text{ pixels} \cdot \frac{3.9 \text{ mm}}{5.2 \text{ mm}} = 3672 \text{ pixels}$$

As expected, the value estimated from the image is close to the actual value, but not perfectly equal.

References

- [1] Flavio Gonzalez App-Entwicklung. *Samsung Galaxy A70*. URL: https://www.camerafv5.com/devices/manufacturers/samsung/sm-a705_a70q_0/ (visited on 04/19/2022).
- [2] OpenCV. *Camera Calibration*. URL: https://docs.opencv.org/4.x/dc/dbb/tutorial_py_calibration.html (visited on 04/19/2022).
- [3] Noah Snavely. *Estimating the focal length of a photo from EXIF tags*. URL: <http://phototour.cs.washington.edu/focal.html> (visited on 04/19/2022).