Computer Vision - Lab 2
Camera Calibration

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1 Introduction

This lab experience was performed to calibrate a camera from a given set of checkerboard images and to remove distortion from a test image using the previously computed calibration data.

2 Procedure

The first step, after loading the calibration dataset, is to find all corners in each image. This is done in parallel on 4 separate threads, since each image is independent from the others. Furthermore, after locating all corners, their coordinates are refined through the use of the function `cv::cornerSubPix`. When all images are correctly processed, the actual calibration data are computed through the function `cv::calibrateCamera`. The program was tested with two different input configurations: **Test A** only contained the first 12 images from the dataset, while **Test B** contained all 57 of them. This was done to get an idea about the impact of a much larger dataset on camera calibration.

3 Results

Test A provided the parameters displayed in *Figure 1* and was completed in around $1.5s$.

```
*****************************************************************************
************************** CALIBRATION RESULTS **************************
*** INTRINSIC PARAMETERS ------------------------------------------------ ***
*** -- alpha_u = 1243.51 ------------------------------------------------ ***
*** -- alpha_v = 1244.33 ------------------------------------------------ ***
*** -- u_0     =  973.77 ------------------------------------------------ ***
*** -- v_0     =  679.52 ------------------------------------------------ ***
*** ------------------------------------------------------------------------ ***
*** DISTORTION PARAMETERS ----------------------------------------------- ***
*** -- Radial:     k_1 = -3.11e-01 | k_2 =  1.49e-01 | k_3 = -4.59e-02  ***
*** -- Tangential: p_1 =  2.83e-05 | p_2 =  1.37e-04 ------------------- ***
*****************************************************************************
Mean reprojection error: 0.147329
Best image: "data/checkerboard_images\0006_color.png"; error: 0.076027
Worst image: "data/checkerboard_images\0009_color.png"; error: 0.653076
```

Figure 1: calibration data with 12 input images.

Test B provided the parameters displayed in *Figure 2* and was completed in around $22s$.

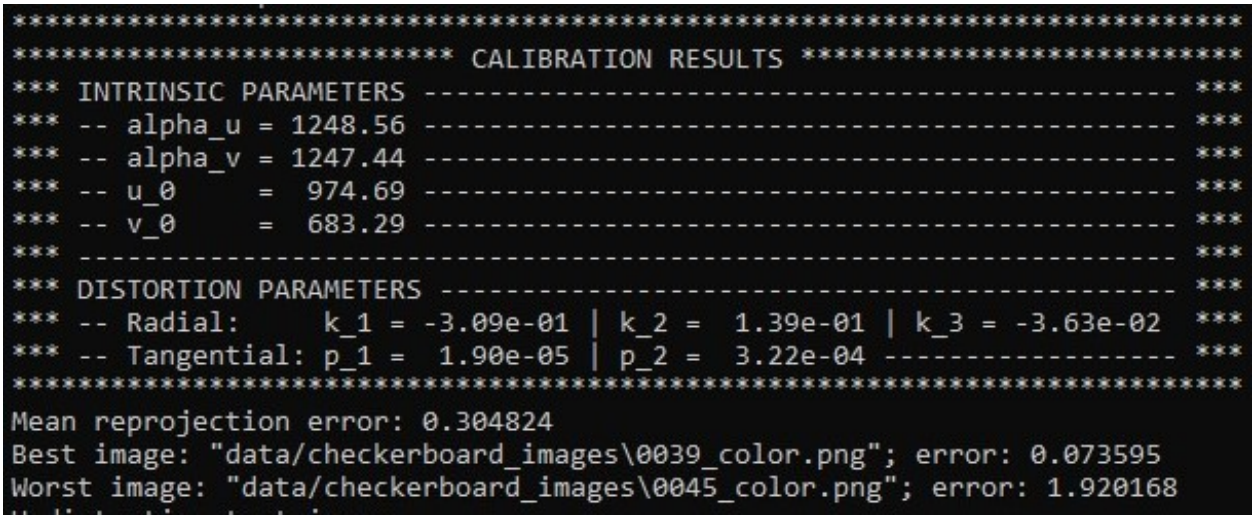

Figure 2: calibration data with 57 input images.

The results from distortion removal can be seen in *Figures 3* and *4*.
The output images are almost identical, but if we look at the data, we notice that calibrating with too many images actually has a negative impact on the reprojection error. Furthermore, **Test B** was almost 15 times slower than **Test A**. This means that the optimal amount of images for camera calibration has to be chosen carefully in order to avoid overfitting.

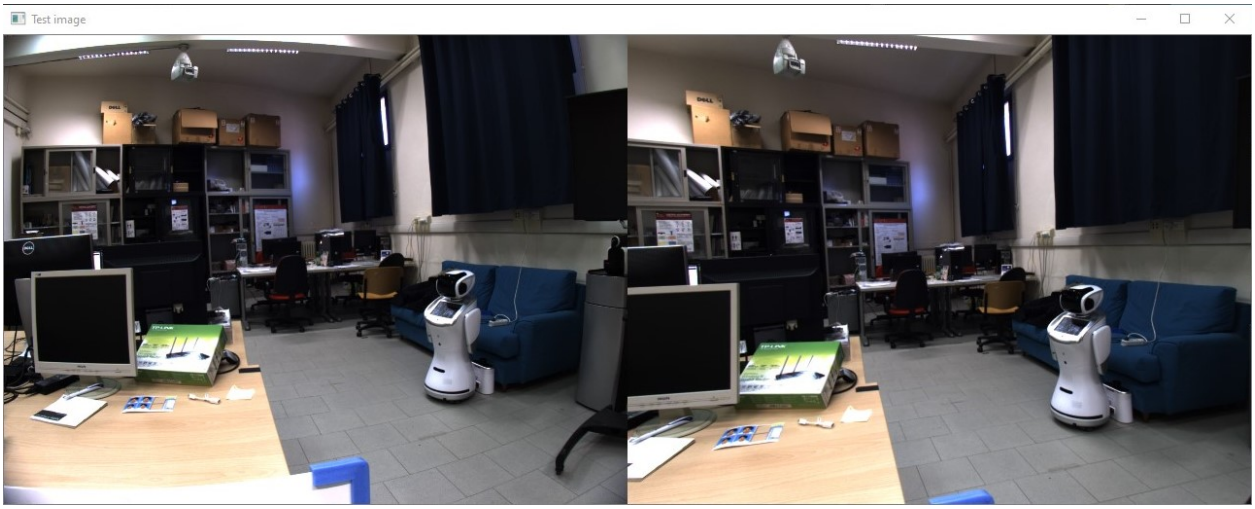

Figure 3: distortion removal after calibration with 12 images.

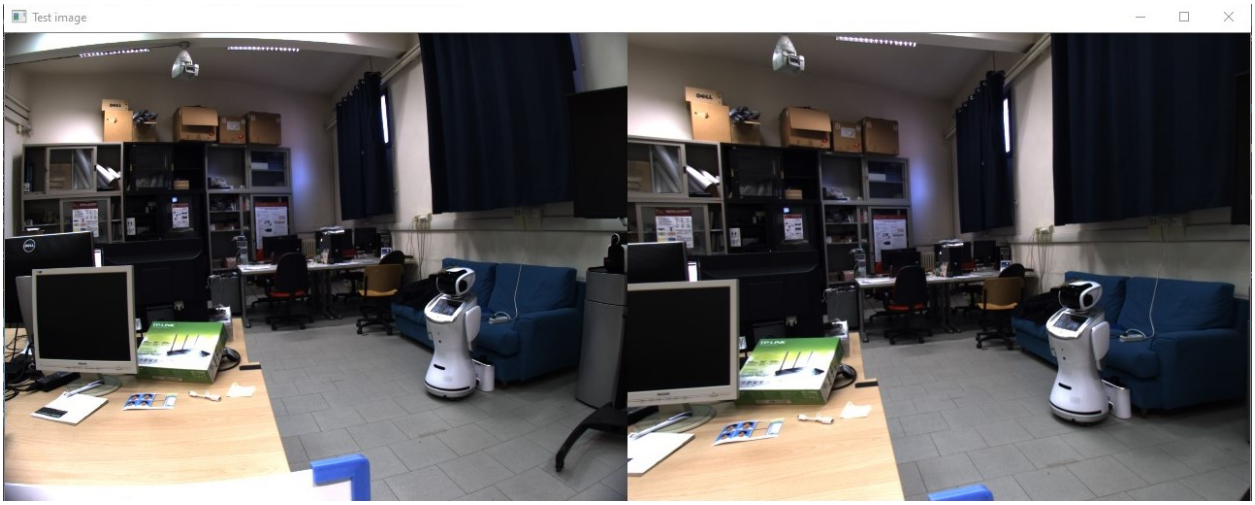

Figure 4: distortion removal after calibration with 57 images.