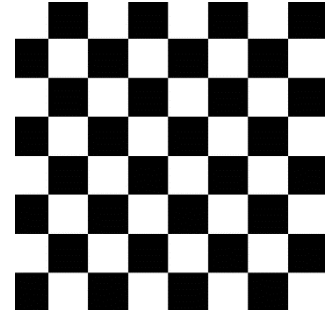


Repte 1:

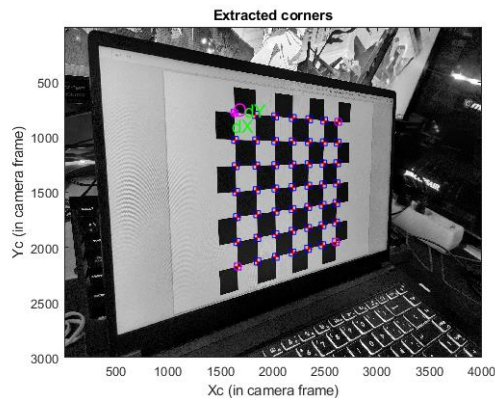
Calibrant una càmera domèstica

Utilitzarem un patró de taulell d'escacs mostrat en una pantalla plana per tal de fer un calibratge a una càmera d'un OnePlus 7 Pro.

S'han fet un total de 11 fotografies en diferents angles i distàncies, amb les quals s'intentaran calibrar el màxim possible gràcies a l'eina *Camera Calibration Tool* d'en *Jean-Yves Bouquet*.



Patró utilitzat



Calibration parameters after initialization:

```
Focal Length:      fc = [ 3048.82289   3048.82289 ]
Principal point:    cc = [ 1999.50000   1499.50000 ]
Skew:              alpha_c = [ 0.00000 ] => angle of pixel = 90.00000 degrees
Distortion:        kc = [ 0.00000   0.00000   0.00000   0.00000   0.00000 ]
```

Main calibration optimization procedure - Number of images: 11

Gradient descent iterations: 1...2...3...4...5...6...7...8...9...10...11...12...13...14...15...16...17...18...19...20...done
Estimation of uncertainties...done

Calibration results after optimization (with uncertainties):

```
Focal Length:      fc = [ 3140.17392   3064.70742 ] +/- [ 13.22283   12.00100 ]
Principal point:    cc = [ 1984.34259   1579.33153 ] +/- [ 17.27951   18.38737 ]
Skew:              alpha_c = [ 0.00000 ] +/- [ 0.00000 ] => angle of pixel axes = 90.00000 +/- 0.00000 degrees
Distortion:        kc = [ 0.11864   -0.53105   0.00356   0.00143   0.00000 ] +/- [ 0.02957   0.16711   0.00233   0.00211   0.00000 ]
Pixel error:       err = [ 1.22996   1.73524 ]
```

Note: The numerical errors are approximately three times the standard deviations (for reference).

Aquests són els resultats que ens dona el primer calibratge amb la selecció manual de les quatre cantonades del tauler. Després d'aplicar la correcció veiem com canvia l'error per píxel: on abans teníem un valor de [1.22996, 1.73524] tenim un resultat de [1.18147, 1.52269].

Aspect ratio optimized (est_aspect_ratio = 1) -> both components of fc are estimated (DEFAULT).

Principal point optimized (center_optim=1) - (DEFAULT). To reject principal point, set center_optim=0

Skew not optimized (est_alpha=0) - (DEFAULT)

Distortion not fully estimated (defined by the variable est_dist):

Sixth order distortion not estimated (est_dist(5)=0) - (DEFAULT) .

Main calibration optimization procedure - Number of images: 11

Gradient descent iterations: 1...2...3...4...5...6...7...8...9...10...11...12...13...14...15...16...17...18...19...done

Estimation of uncertainties...done

Calibration results after optimization (with uncertainties):

```
Focal Length:      fc = [ 3137.18224   3063.14458 ] +/- [ 11.97441   10.86145 ]
Principal point:    cc = [ 1986.34697   1574.27061 ] +/- [ 15.58606   16.49355 ]
Skew:              alpha_c = [ 0.00000 ] +/- [ 0.00000 ] => angle of pixel axes = 90.00000 +/- 0.00000 degrees
Distortion:        kc = [ 0.12355   -0.56004   0.00273   0.00149   0.00000 ] +/- [ 0.02689   0.15214   0.00208   0.00191   0.00000 ]
Pixel error:       err = [ 1.18147   1.52269 ]
```

Note: The numerical errors are approximately three times the standard deviations (for reference).

Pixel error: err = [1.18147 1.52269] (all active images)

done

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Aquest no és un canvi molt significatiu, però amb una precisió més gran es podrien millorar els resultats tant de les distorsions com de l'error de la imatge.

Tal com diu l'enunciat, intentarem eliminar la distorsió geomètrica que té la imatge. Per tal tasca executarem les comandes “*est_dist = [0;0;0;0;0]*” i “*est_aspect_ratio = 0*”. Els resultats finals eliminen totalment la distorsió de la imatge, però per contra afegeixen error al resultat final.

```
>> est_dist = [0;0;0;0;0];
>> est_aspect_ratio = 0;

Aspect ratio not optimized (est_aspect_ratio = 0) -> fc(1)=fc(2). Set est_aspect_ratio to 1 for estimating aspect ratio.
Principal point optimized (center_optim=1) - (DEFAULT). To reject principal point, set center_optim=0
Skew not optimized (est_alpha=0) - (DEFAULT)
Distortion not fully estimated (defined by the variable est_dist):
    Second order distortion not estimated (est_dist(1)=0).
    Fourth order distortion not estimated (est_dist(2)=0).
    Sixth order distortion not estimated (est_dist(5)=0) - (DEFAULT) .
    Tangential distortion not estimated (est_dist(3:4)~= [1;1]).

Main calibration optimization procedure - Number of images: 11
Gradient descent iterations: 1...2...3...4...5...6...7...8...9...10...11...12...13...14...15...16...17...18...19...done
Estimation of uncertainties...done

Calibration results after optimization (with uncertainties):

Focal Length:      fc = [ 3046.69263   3046.69263 ] +/- [ 24.46800   24.46800 ]
Principal point:    cc = [ 2013.70163   1524.88939 ] +/- [ 17.43710   15.97352 ]
Skew:              alpha_c = [ 0.00000 ] +/- [ 0.00000 ] => angle of pixel axes = 90.00000 +/- 0.00000 degrees
Distortion:         kc = [ 0.00000   -0.00000   0.00000   0.00000   0.00000 ] +/- [ 0.00000   0.00000   0.00000   0.00000   0.00000 ]
Pixel error:        err = [ 3.12583   3.32808 ]

Note: The numerical errors are approximately three times the standard deviations (for reference).

Pixel error:        err = [ 3.12583   3.32808 ] (all active images)
```

