1-calibracion

July 19, 2022

1 Calibración de la Cámara usando OpenCV

1.1 0. Resumen

1. Patrón
2. Sacar fotos desde diferentes puntos de vista
3. Encontrar esquinas
4. Ecuaciones de proyección patrón->foto

$$s \begin{bmatrix} u_i \\ v_i \\ 1 \end{bmatrix} = \begin{bmatrix} K \end{bmatrix} \begin{bmatrix} R_k | t_k \end{bmatrix} \begin{bmatrix} X_i \\ Y_i \\ Z_i \\ 1 \end{bmatrix} \tag{1}$$

K: 5 (o 4) parámetros

R: 5 (o 9) parámetros

t: 3 parámetros

5. Hallar K, R_k, t_k y de yapa los coeficientes de distorsión.
6. Rectificar la imagen

7. Bonus: dibujar en 3D

[1]:
```
import cv2
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
print("OpenCV version " + cv2.__version__)
print("Numpy version " + np.__version__)
```

```
OpenCV version 4.6.0
Numpy version 1.23.1
```

[2]:
```
import glob

import PIL.ExifTags
import PIL.Image
```

2 Calibracion de parametros intrinsecos

2.1 Fotos desde distintos puntos de vista

[3]:
```
calib_fnames = glob.glob('./imagenes_tp/img_cal_set1/*')

mostrar_figuras = True
```

2.1.1 Identificación de Esquinas, Encontrar Matriz de Cámara

[4]:
```
size_chess_table = 28
```

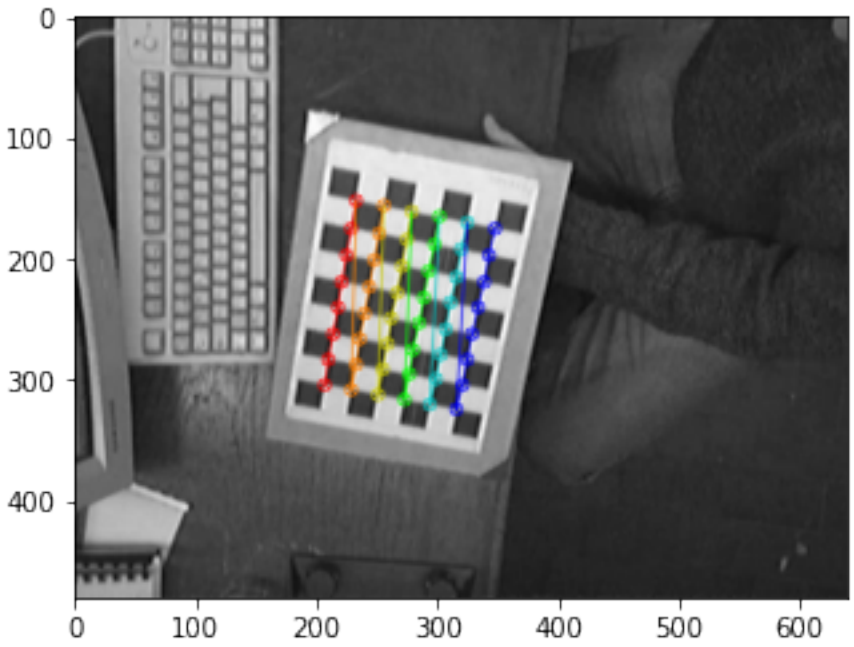
[5]:
```
def table_size():
    # Tamaño del tablero:
    ch_size = (8, 6)

    # Lista de los puntos que vamos a reconocer en el mundo
    # objp={(0,0,0), (1,0,0), (2,0,0) .... }
    # corresponden a las coordenadas en el tablero de ajedrez.
    objp = np.zeros((np.prod(ch_size), 3),  dtype=np.float32)
    objp[:, :2] = np.mgrid[0:ch_size[0], 0:ch_size[1]].T.reshape(-1, 2)
    objp = objp * size_chess_table

    return objp, ch_size
```

[6]:
```
def calib(calib_fnames):
    # lista de todos los puntos que vamos a recolectar
    obj_points = list()
    img_points = list()
    objp, ch_size = table_size()

    ## Criterio de corte para el proceso iterativo de refinamientoi de esquinas.
    # Parar si iteramos maxCount veces o si las esquinas se mueven menos de␣
↪epsilon
    maxCount = 30
    epsilon = 0.001
    criteria = (cv2.TERM_CRITERIA_EPS | cv2.TERM_CRITERIA_MAX_ITER, maxCount,␣
↪epsilon)
    cb_flags = cv2.CALIB_CB_ADAPTIVE_THRESH
    # cb_flags = cv2.CALIB_CB_FAST_CHECK

    #%matplotlib qt

    for image_fname in calib_fnames:
        print("Procesando: " + image_fname , end='... ')
        img = cv2.imread(image_fname)
```

```
        img_gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY) # para subpixel␣
↪solamente gray
        ret, corners = cv2.findChessboardCorners(img_gray, ch_size,␣
↪flags=cb_flags)
        if ret:
            print('Encontramos esquinas!')
            obj_points.append(objp)
            print('Buscando esquinas en resolución subpixel', end='... ')
            corners_subp = cv2.cornerSubPix(img_gray, corners, (5, 5), (-1, -1),␣
↪criteria)
            print('OK!')
            img_points.append(corners_subp)
            cv2.drawChessboardCorners(img, ch_size, corners_subp, ret)
            if mostrar_figuras:
                plt.figure()
                plt.imshow(cv2.cvtColor(img, cv2.COLOR_BGR2RGB))
                plt.show()

    return obj_points, img_points, img_gray, img
```

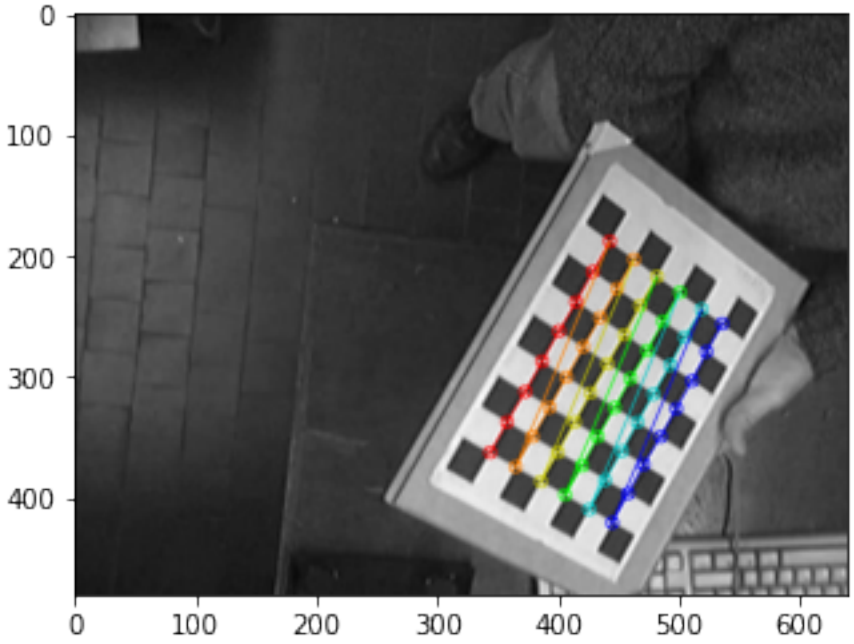
[7]:
```
obj_points, img_points, img_gray, img = calib(calib_fnames)
```

```
Procesando: ./imagenes_tp/img_cal_set1/img_cal1.png... Encontramos esquinas!
Buscando esquinas en resolución subpixel... OK!
```

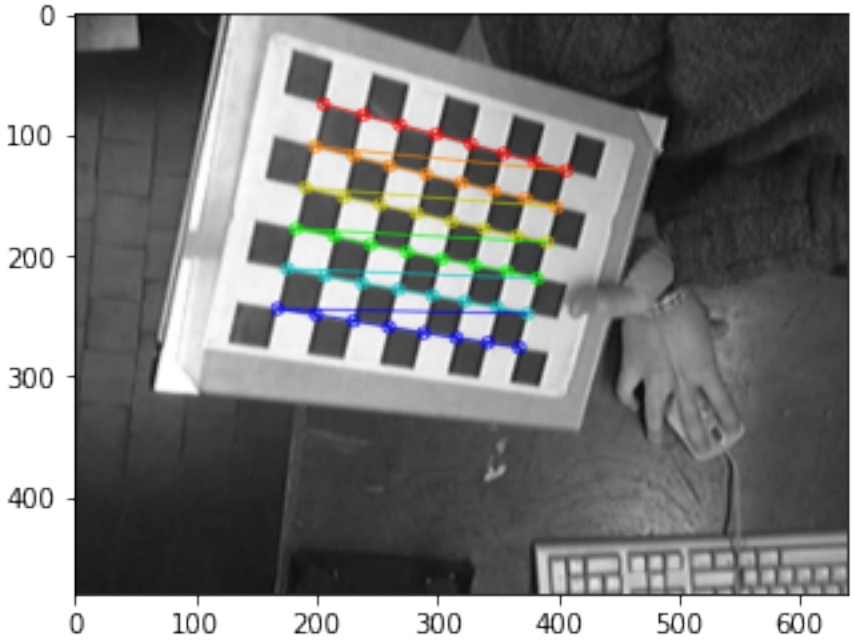



```
Procesando: ./imagenes_tp/img_cal_set1/img_cal14.png... Encontramos esquinas!
```

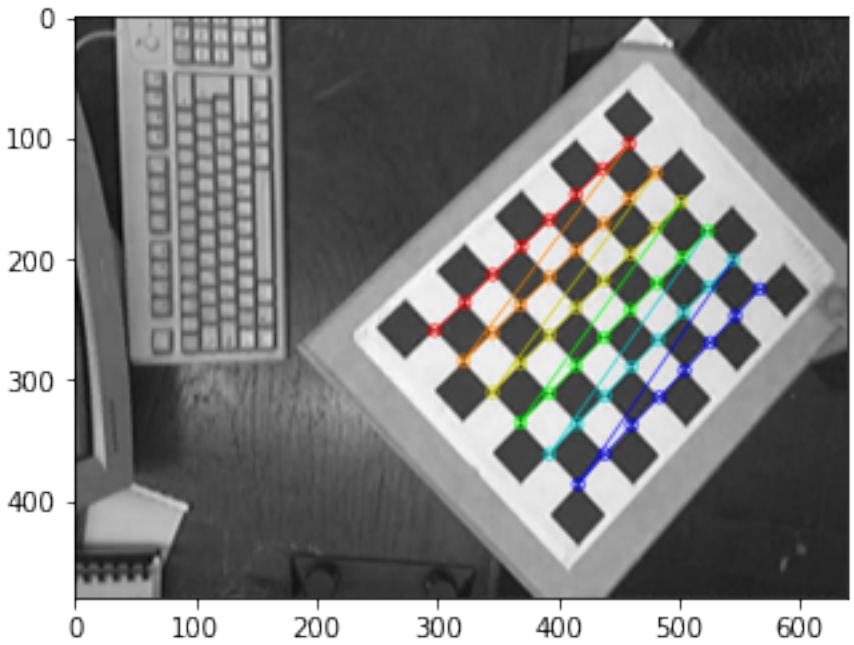
```
Buscando esquinas en resolución subpixel... OK!
```



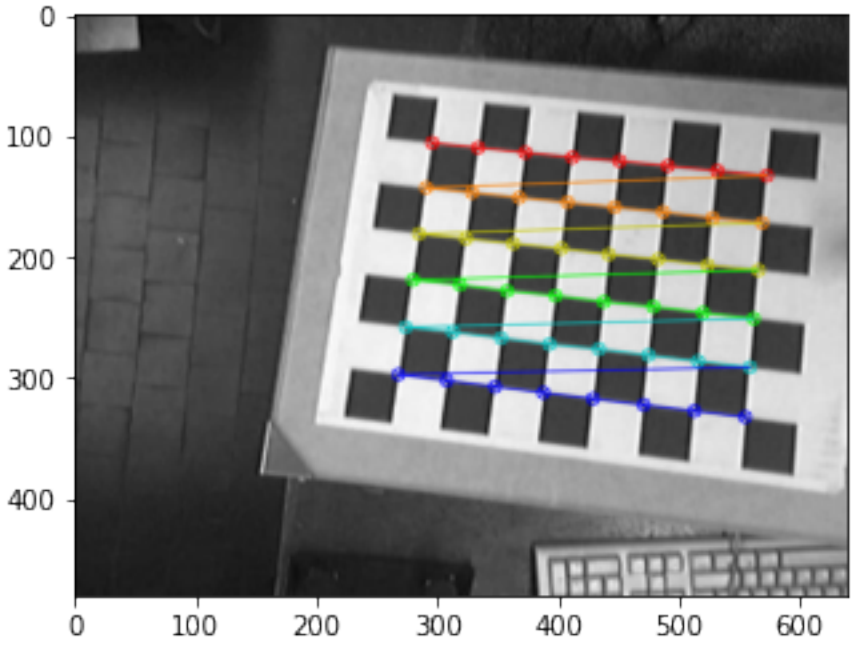

```
Procesando: ./imagenes_tp/img_cal_set1/img_cal15.png... Encontramos esquinas!
Buscando esquinas en resolución subpixel... OK!
```



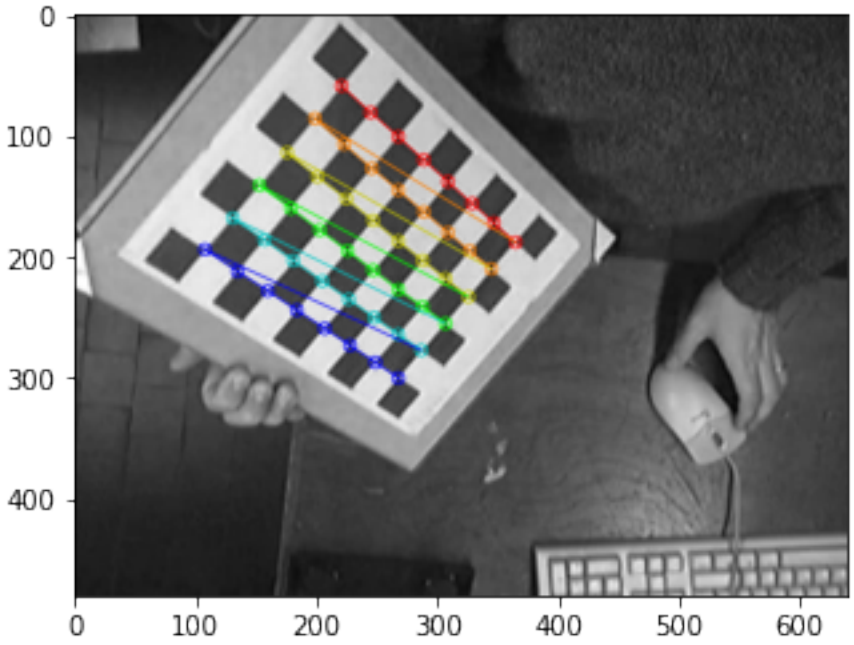
```
Procesando: ./imagenes_tp/img_cal_set1/img_cal2.png... Encontramos esquinas!
Buscando esquinas en resolución subpixel... OK!
```



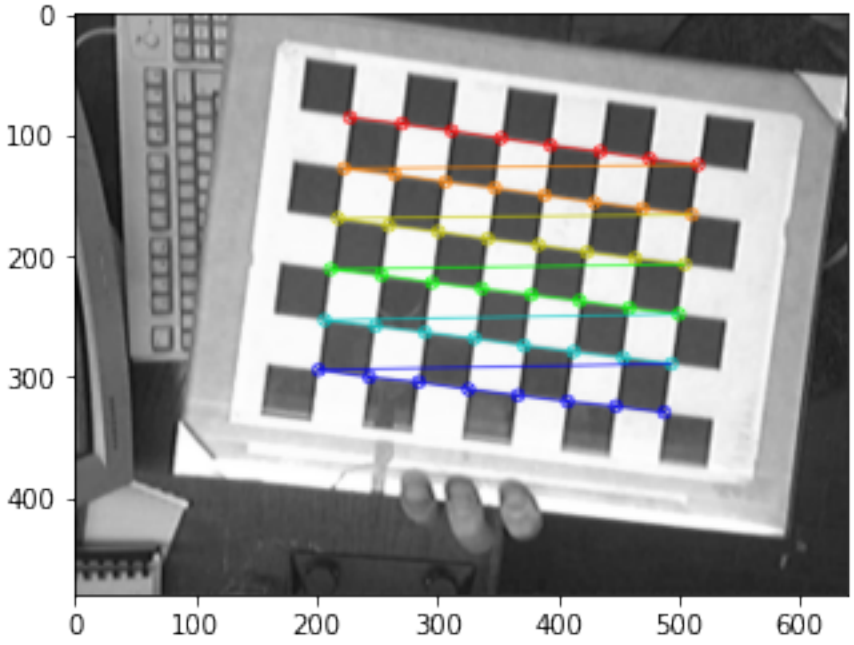

```
Procesando: ./imagenes_tp/img_cal_set1/img_cal17.png... Encontramos esquinas!
Buscando esquinas en resolución subpixel... OK!
```



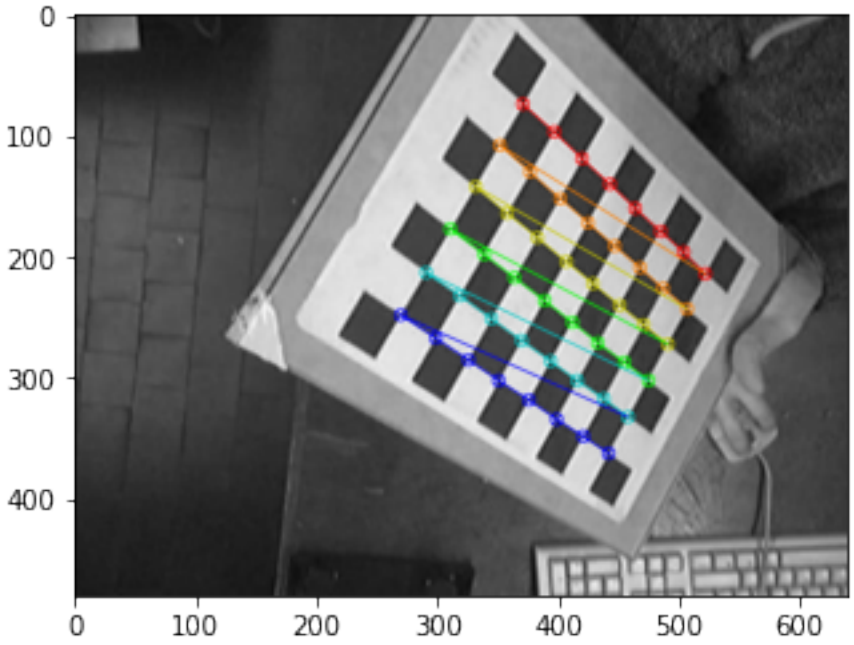
```
Procesando: ./imagenes_tp/img_cal_set1/img_cal16.png... Encontramos esquinas!
Buscando esquinas en resolución subpixel... OK!
```



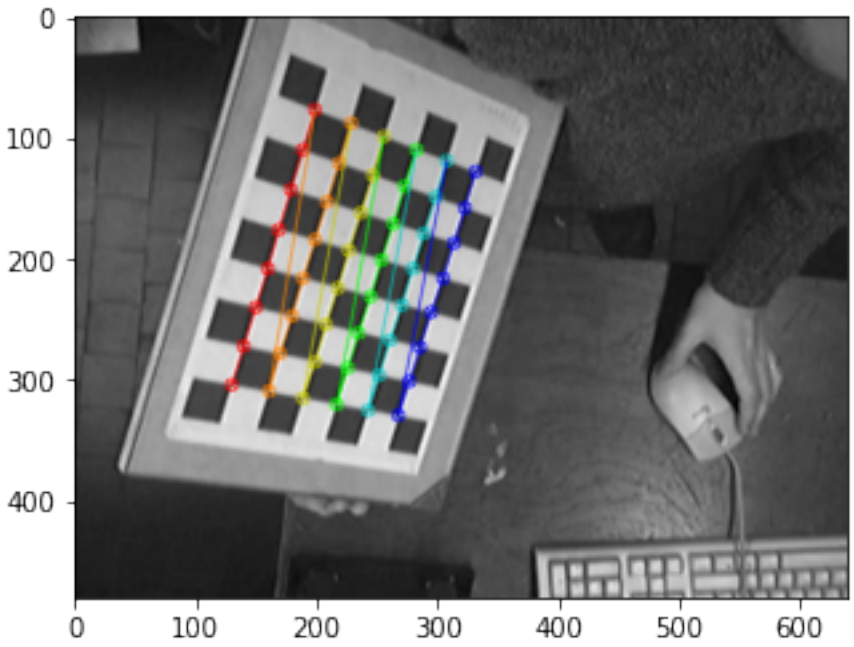

```
Procesando: ./imagenes_tp/img_cal_set1/img_cal3.png... Encontramos esquinas!
Buscando esquinas en resolución subpixel... OK!
```



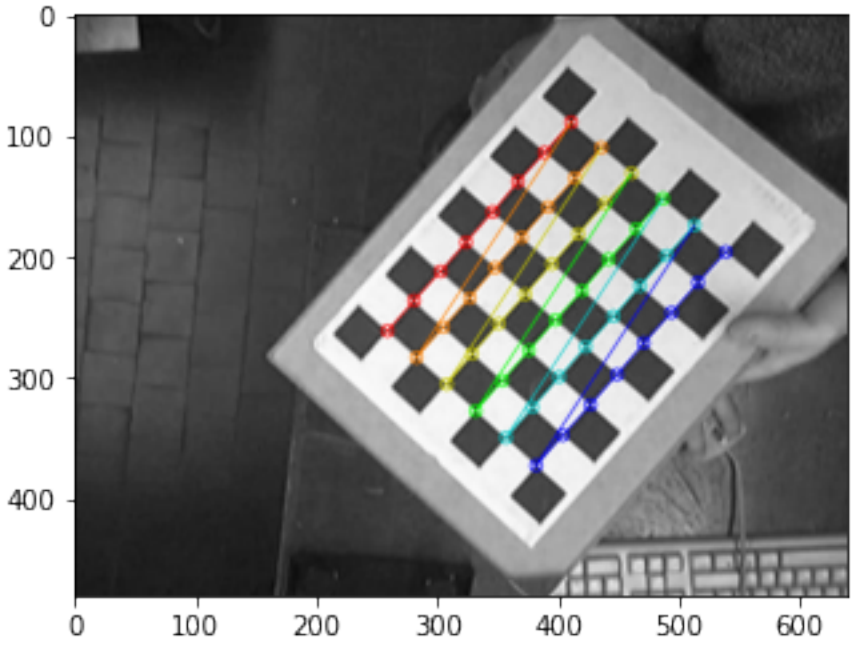
```
Procesando: ./imagenes_tp/img_cal_set1/img_cal7.png... Encontramos esquinas!
Buscando esquinas en resolución subpixel... OK!
```




```
Procesando: ./imagenes_tp/img_cal_set1/img_cal12.png... Encontramos esquinas!
Buscando esquinas en resolución subpixel... OK!
```

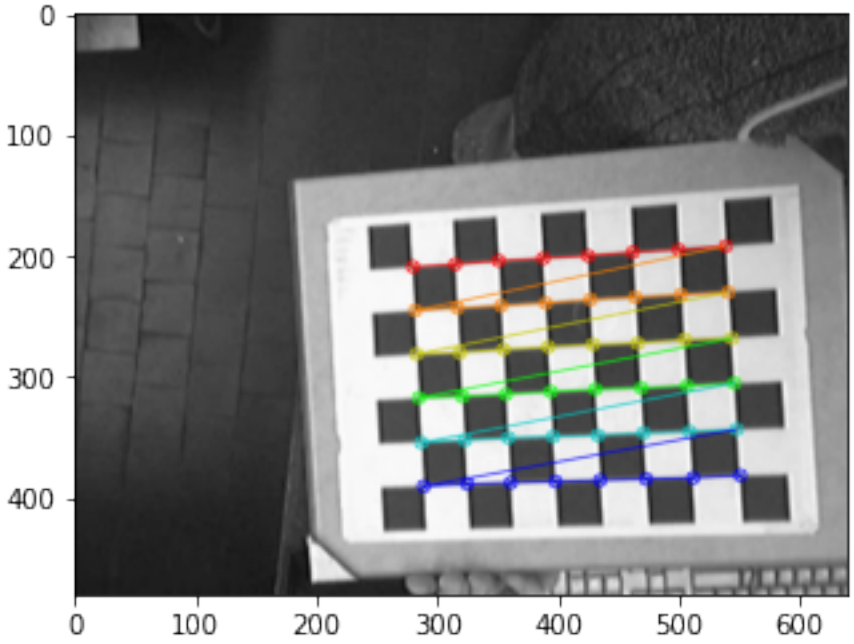



```
Procesando: ./imagenes_tp/img_cal_set1/img_cal13.png... Encontramos esquinas!
Buscando esquinas en resolución subpixel... OK!
```

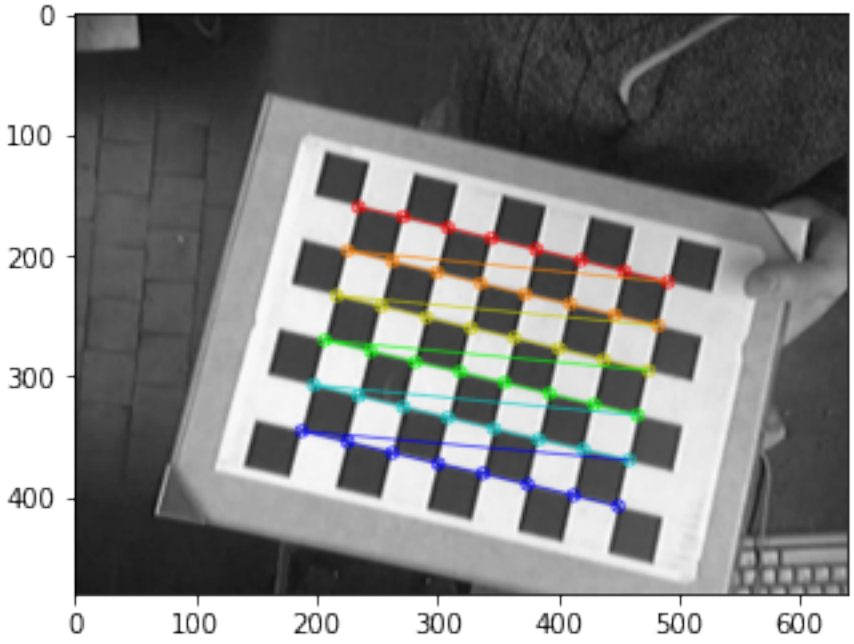



```
Procesando: ./imagenes_tp/img_cal_set1/img_cal6.png... Encontramos esquinas!
```

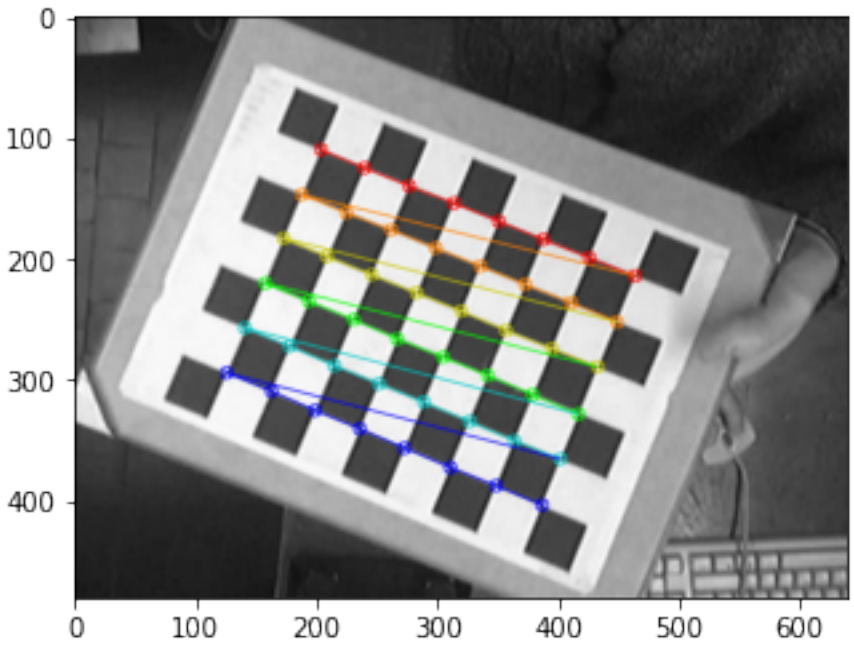
```
Buscando esquinas en resolución subpixel... OK!
```



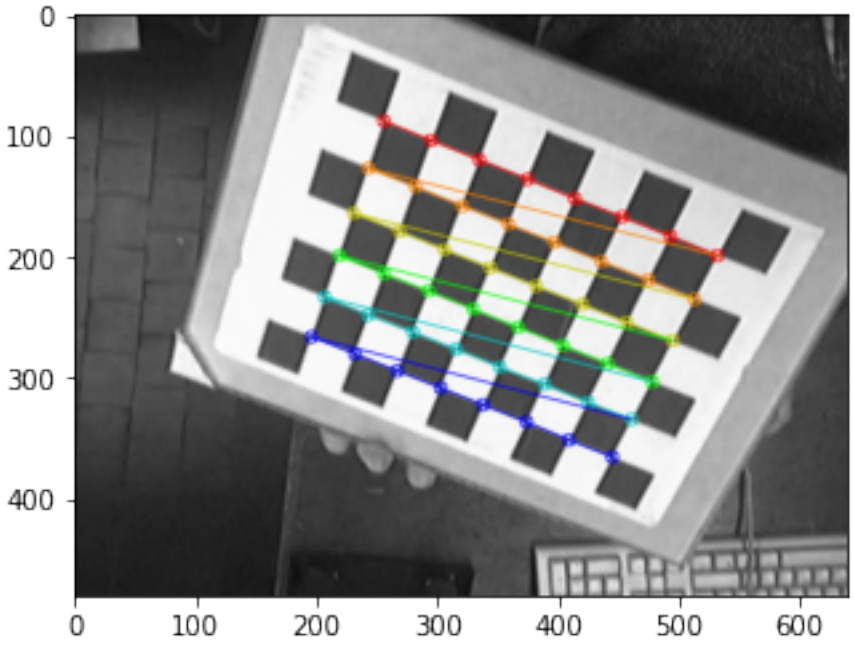

```
Procesando: ./imagenes_tp/img_cal_set1/img_cal4.png... Encontramos esquinas!
Buscando esquinas en resolución subpixel... OK!
```



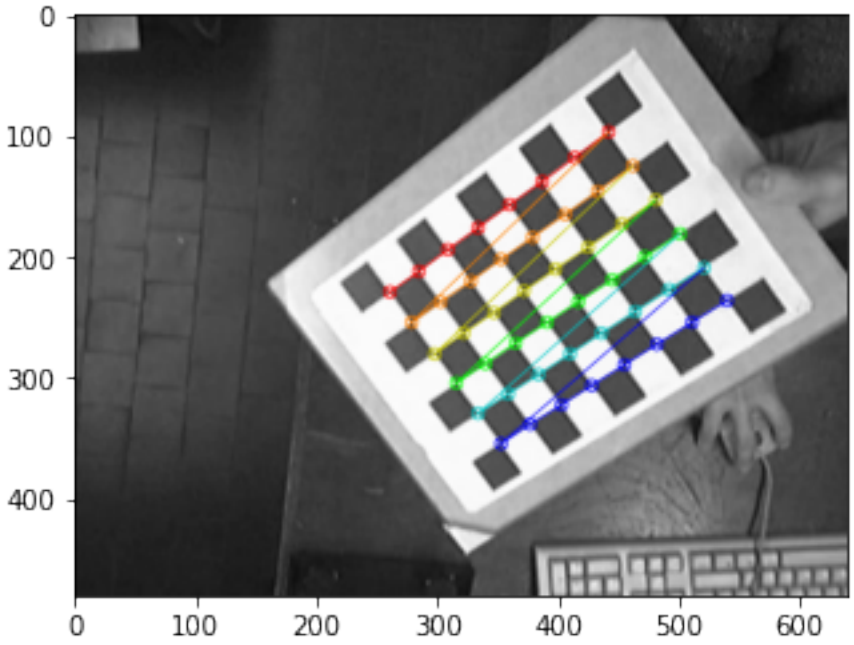
```
Procesando: ./imagenes_tp/img_cal_set1/img_cal11.png... Encontramos esquinas!
Buscando esquinas en resolución subpixel... OK!
```



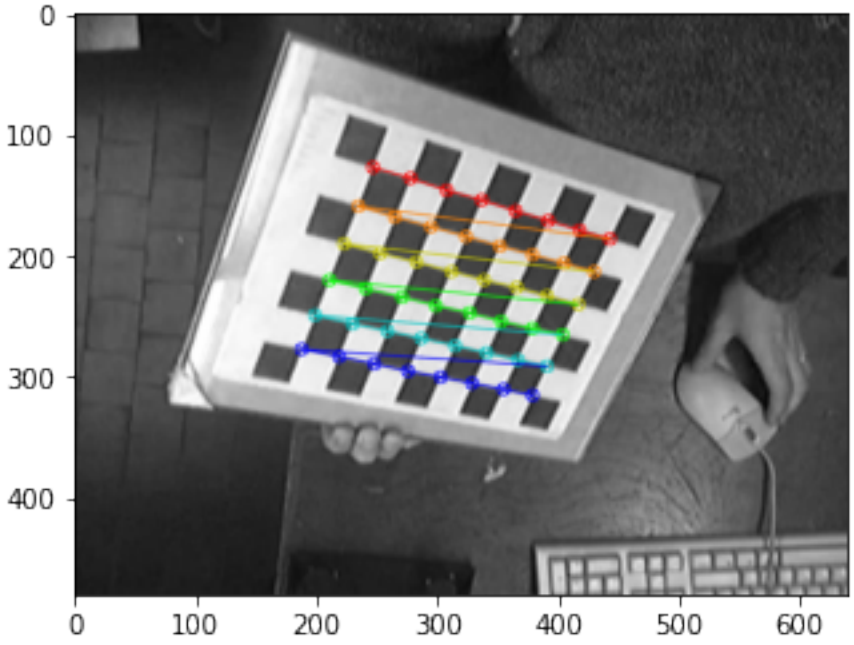

```
Procesando: ./imagenes_tp/img_cal_set1/img_cal10.png... Encontramos esquinas!
Buscando esquinas en resolución subpixel... OK!
```



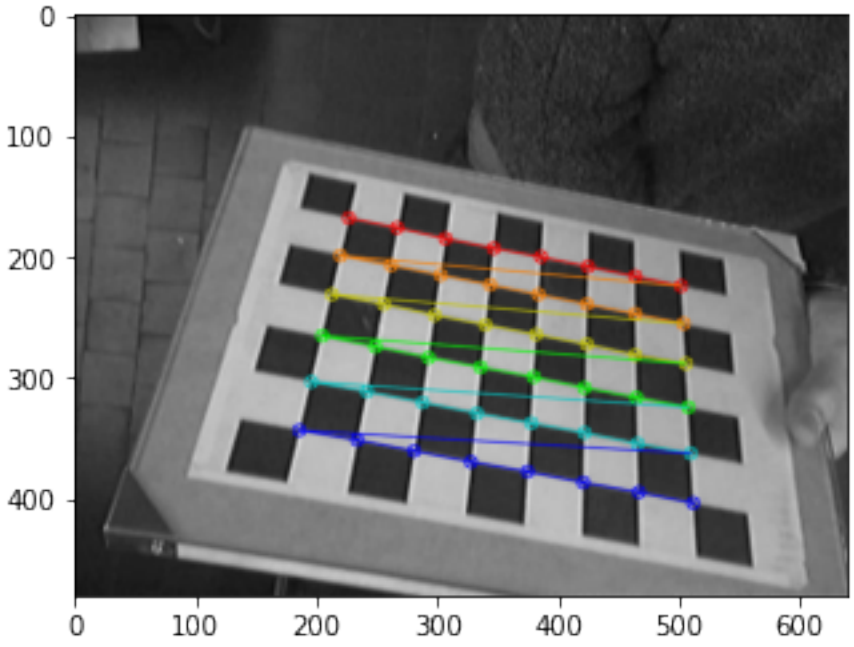
```
Procesando: ./imagenes_tp/img_cal_set1/img_cal5.png... Encontramos esquinas!
Buscando esquinas en resolución subpixel... OK!
```



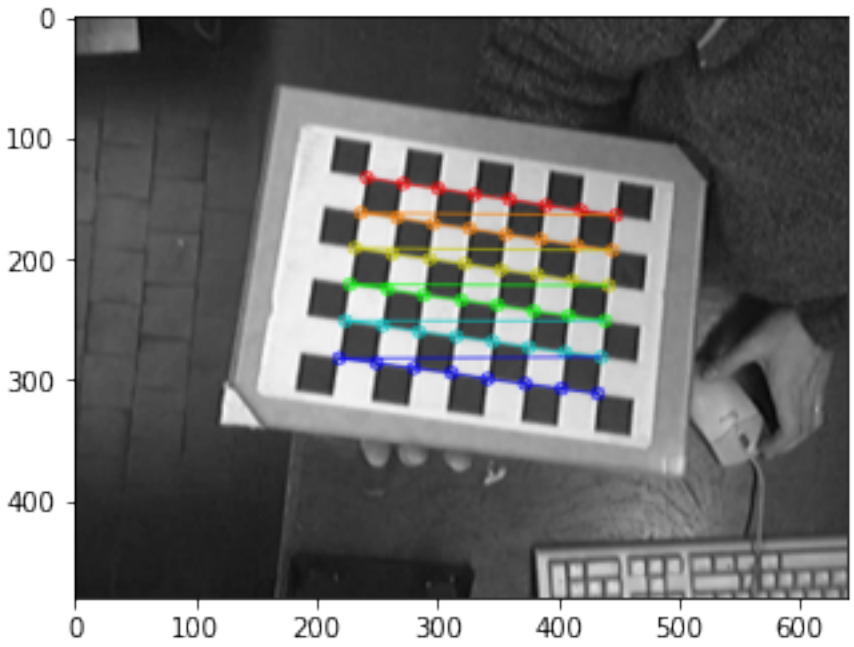

```
Procesando: ./imagenes_tp/img_cal_set1/img_cal8.png... Encontramos esquinas!
Buscando esquinas en resolución subpixel... OK!
```



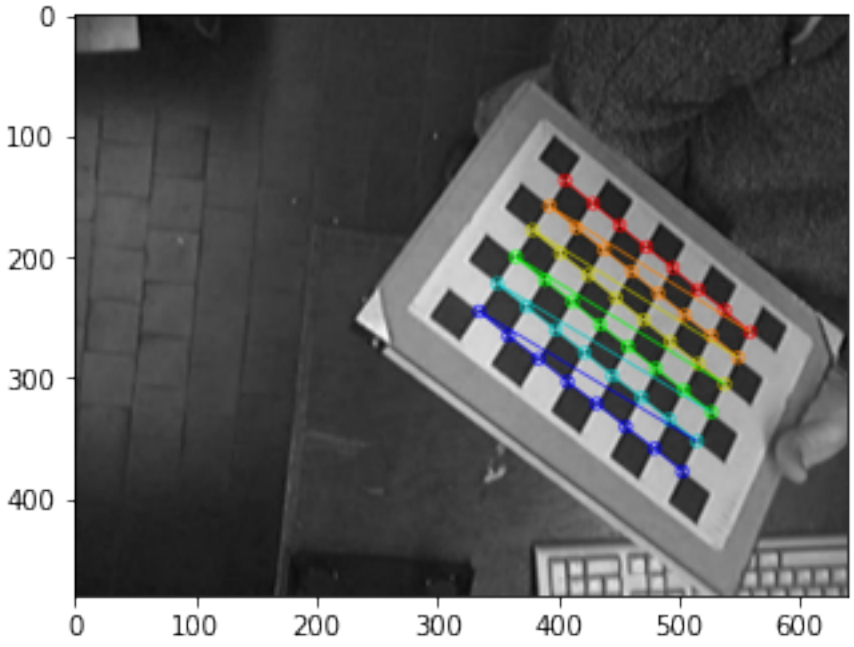
```
Procesando: ./imagenes_tp/img_cal_set1/img_cal20.png... Encontramos esquinas!
Buscando esquinas en resolución subpixel... OK!
```




```
Procesando: ./imagenes_tp/img_cal_set1/img_cal9.png... Encontramos esquinas!
Buscando esquinas en resolución subpixel... OK!
```

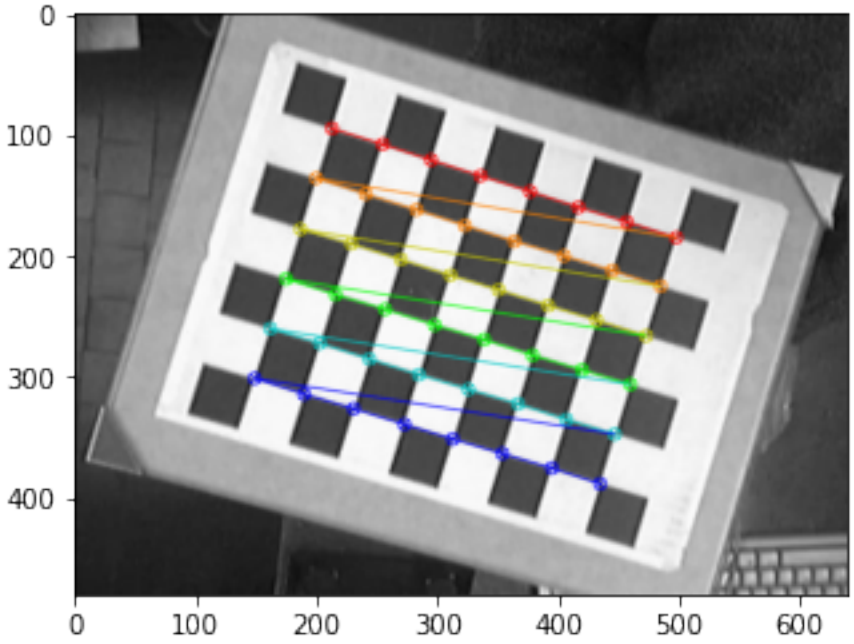



```
Procesando: ./imagenes_tp/img_cal_set1/img_cal18.png... Encontramos esquinas!
Buscando esquinas en resolución subpixel... OK!
```




```
Procesando: ./imagenes_tp/img_cal_set1/img_cal19.png... Encontramos esquinas!
```

```
Buscando esquinas en resolución subpixel... OK!
```



2.1.2 Eliminar ciertas imagenes

Debido a que en algunos casos la terna encontrada no corresponde a la misma esquina del tablero, para simplificar lo nombro borde lateral balnco mas ancho, se toma la desicion de quitar las images:
- 5,6,7,8,9,10,11

[8]:
```
calib_fnames
```

[8]:
```
['./imagenes_tp/img_cal_set1/img_cal1.png',
 './imagenes_tp/img_cal_set1/img_cal14.png',
 './imagenes_tp/img_cal_set1/img_cal15.png',
 './imagenes_tp/img_cal_set1/img_cal2.png',
 './imagenes_tp/img_cal_set1/img_cal17.png',
 './imagenes_tp/img_cal_set1/img_cal16.png',
 './imagenes_tp/img_cal_set1/img_cal3.png',
 './imagenes_tp/img_cal_set1/img_cal7.png',
 './imagenes_tp/img_cal_set1/img_cal12.png',
 './imagenes_tp/img_cal_set1/img_cal13.png',
 './imagenes_tp/img_cal_set1/img_cal6.png',
 './imagenes_tp/img_cal_set1/img_cal4.png',
 './imagenes_tp/img_cal_set1/img_cal11.png',
 './imagenes_tp/img_cal_set1/img_cal10.png',
 './imagenes_tp/img_cal_set1/img_cal5.png',
 './imagenes_tp/img_cal_set1/img_cal8.png',
```

```
 './imagenes_tp/img_cal_set1/img_cal20.png',
 './imagenes_tp/img_cal_set1/img_cal9.png',
 './imagenes_tp/img_cal_set1/img_cal18.png',
 './imagenes_tp/img_cal_set1/img_cal19.png']
```

[9]:
```
valid_images = [1,2,3,4,12,13,14,15]
calib_fnames_valid = [f'./imagenes_tp/img_cal_set1/img_cal{n}.png' for n in␣
 ↪valid_images]

mostrar_figuras = False

obj_points, img_points, img_gray, img = calib(calib_fnames_valid)
```

```
Procesando: ./imagenes_tp/img_cal_set1/img_cal1.png... Encontramos esquinas!
Buscando esquinas en resolución subpixel... OK!
Procesando: ./imagenes_tp/img_cal_set1/img_cal2.png... Encontramos esquinas!
Buscando esquinas en resolución subpixel... OK!
Procesando: ./imagenes_tp/img_cal_set1/img_cal3.png... Encontramos esquinas!
Buscando esquinas en resolución subpixel... OK!
Procesando: ./imagenes_tp/img_cal_set1/img_cal4.png... Encontramos esquinas!
Buscando esquinas en resolución subpixel... OK!
Procesando: ./imagenes_tp/img_cal_set1/img_cal12.png... Encontramos esquinas!
Buscando esquinas en resolución subpixel... OK!
Procesando: ./imagenes_tp/img_cal_set1/img_cal13.png... Encontramos esquinas!
Buscando esquinas en resolución subpixel... OK!
Procesando: ./imagenes_tp/img_cal_set1/img_cal14.png... Encontramos esquinas!
Buscando esquinas en resolución subpixel... OK!
Procesando: ./imagenes_tp/img_cal_set1/img_cal15.png... Encontramos esquinas!
Buscando esquinas en resolución subpixel... OK!
```

2.2 Calibración

Listo con la identificación de puntos, ahora a calibrar

[10]:
```
ret, mtx, dist, rvecs, tvecs = cv2.calibrateCamera(obj_points, img_points,
                                                   img_gray.shape[::-1], None,␣
 ↪None,flags=cv2.CALIB_ZERO_TANGENT_DIST)

#distCoeffs - Output vector of distortion coefficients
#disotorsion tangencial p1=0,p2=0, puedo hacer cero a k2 y k3
dist[0][1]=0
dist[0][4]=0


print('Camera Matrix = ')
print(mtx)
print('Distortion Coefficients = ')
```

```
print(dist)
```

```
Camera Matrix =
[[811.31174395   0.         315.73355982]
 [  0.         811.74299018 243.60518088]
 [  0.           0.           1.        ]]
Distortion Coefficients =
[[0.04997142 0.         0.         0.         0.        ]]
```

2.2.1 SET 1:

- Camera Matrix = [[811.31174395 0. 315.73355982] [0. 811.74299018 243.60518088] [0. 0. 1.]]
- Distortion Coefficients = [[0.04997142 0. 0. 0. 0.]]

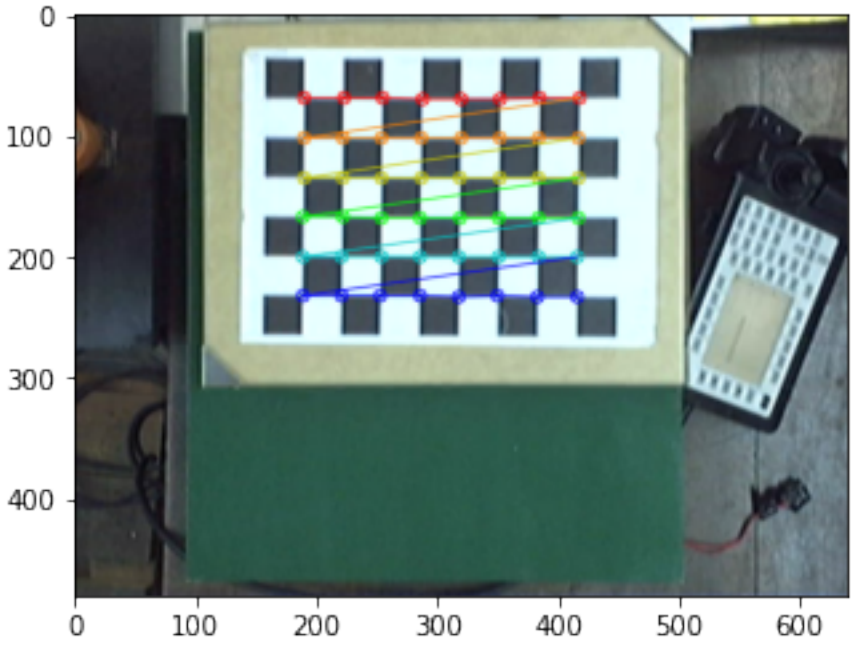
[11]:
```
pd.DataFrame(mtx).to_csv("./save_data/camara_matrix.csv", index=False)
pd.DataFrame(dist).to_csv("./save_data/dist_coefficients.csv", index=False)
```

3 Calibrar Parametros Extrinsecos

[12]:
```
calib_fnames_extr = glob.glob('./imagenes_tp/img_bloques/imgCalExtr.png')
mostrar_figuras = True
```

[13]:
```
obj_points_extr, img_points_extr, img_gray_extr, img = calib(calib_fnames_extr)
```

```
Procesando: ./imagenes_tp/img_bloques/imgCalExtr.png... Encontramos esquinas!
Buscando esquinas en resolución subpixel... OK!
```



[14]:
```
ret_extr, rvecs_extr, tvecs_extr  = cv2.solvePnP(
    obj_points_extr[0],
    img_points_extr[0],
    mtx,
    dist,
    useExtrinsicGuess=False
)

#Converts a rotation matrix to a rotation vector
rotation = cv2.Rodrigues(rvecs_extr)[0]

print('Rotation = ', rotation)
print('Translation = ', tvecs_extr)
```

```
Rotation =  [[ 0.99919631 -0.00779203  0.03931953]
 [ 0.00771164  0.99996785  0.00219582]
 [-0.03933537 -0.00189083  0.99922428]]
Translation =  [[-108.62975346]
 [-150.3410905 ]
 [ 703.32230507]]
```

[15]:
```
pd.DataFrame(tvecs_extr).to_csv("./save_data/translation_df.csv", index=False)
pd.DataFrame(rotation).to_csv("./save_data/rotation_df.csv", index=False)
```