# Calibrate fisheye lens using OpenCV—part 1

medium.com/@kennethjiang/calibrate-fisheye-lens-using-opencv-333b05afa0b0

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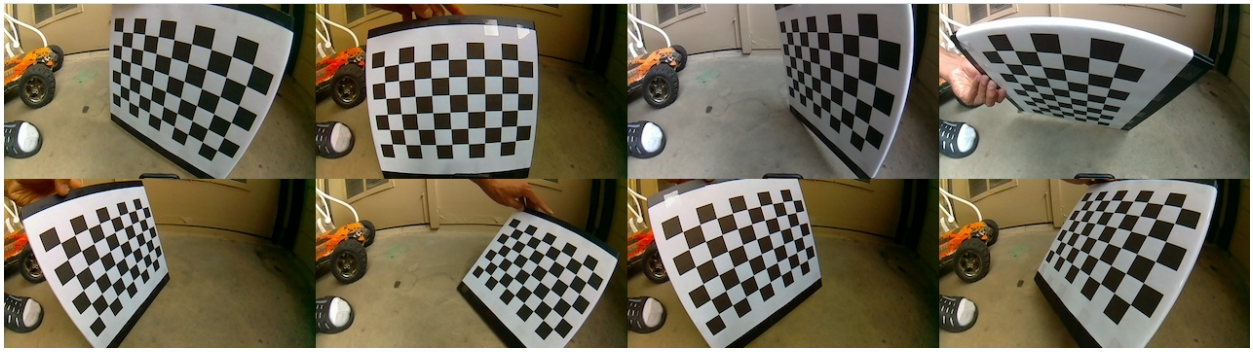
At 30000 feet, calibrating your lens involves 2 steps.

1. Help OpenCV find 2 parameters intrinsic to your lens. OpenCV call them K and D. You don't really need to know what K and D are except they are numpy arrays.
2. Un-distort images by applying K and D.

## Find K and D

- Download the checkerboard pattern and print it on a paper (letter or A4 size). You also want to attach the paper to a hard, flat surface such as a piece of cardboard. The key here: **straight lines need to be straight**.
- Hold the pattern in front of your camera and capture some images. You want to hold the pattern in different positions and angles. The key here: the patterns need to appear distorted **in a different ways** (so that OpenCV knows as much about your lens as possible). Some examples are:



- Save these pictures in a folder in JPG format.
- Now the fun part—write some code. Not really. You just need to copy this piece of Python script to a file creatively named `calibrate.py` in the folder where you saved these images earlier.

```
import cv2
assert cv2.__version__[0] == '3', 'The fisheye module requires opencv version >=
3.0.0'

import numpy as np
import os
import glob

CHECKERBOARD = (6,9)

subpix_criteria = (cv2.TERM_CRITERIA_EPS+cv2.TERM_CRITERIA_MAX_ITER, 30, 0.1)
calibration_flags =
cv2.fisheye.CALIB_RECOMPUTE_EXTRINSIC+cv2.fisheye.CALIB_CHECK_COND+cv2.fisheye.CALIB_FIX_SKEW

objp = np.zeros((1, CHECKERBOARD[0]*CHECKERBOARD[1], 3), np.float32)
objp[0,:,:2] = np.mgrid[0:CHECKERBOARD[0], 0:CHECKERBOARD[1]].T.reshape(-1, 2)
```

```
_img_shape = None
objpoints = [] # 3d point in real world space
imgpoints = [] # 2d points in image plane.

images = glob.glob('*.jpg')

for fname in images:
    img = cv2.imread(fname)
    if _img_shape == None:
        _img_shape = img.shape[:2]
    else:
        assert _img_shape == img.shape[:2], "All images must share the same size."

    gray = cv2.cvtColor(img,cv2.COLOR_BGR2GRAY)
    # Find the chess board corners
    ret, corners = cv2.findChessboardCorners(gray, CHECKERBOARD,
cv2.CALIB_CB_ADAPTIVE_THRESH+cv2.CALIB_CB_FAST_CHECK+cv2.CALIB_CB_NORMALIZE_IMAGE)
    # If found, add object points, image points (after refining them)
    if ret == True:
        objpoints.append(objp)
        cv2.cornerSubPix(gray,corners,(3,3),(-1,-1),subpix_criteria)
        imgpoints.append(corners)

N_OK = len(objpoints)
K = np.zeros((3, 3))
D = np.zeros((4, 1))
rvecs = [np.zeros((1, 1, 3), dtype=np.float64) for i in range(N_OK)]
tvecs = [np.zeros((1, 1, 3), dtype=np.float64) for i in range(N_OK)]
rms, _, _, _, _ = \
    cv2.fisheye.calibrate(
        objpoints,
        imgpoints,
        gray.shape[::-1],
        K,
        D,
        rvecs,
        tvecs,
        calibration_flags,
        (cv2.TERM_CRITERIA_EPS+cv2.TERM_CRITERIA_MAX_ITER, 30, 1e-6)
    )
print("Found " + str(N_OK) + " valid images for calibration")
print("DIM=" + str(_img_shape[::-1]))
print("K=np.array(" + str(K.tolist()) + ")")
print("D=np.array(" + str(D.tolist()) + ")")
```

> Run `python calibrate.py`. If everything goes smoothly the script will print out something like this:

```
Found 36 images for calibration
DIM=(1600, 1200)
K=np.array([[781.3524863867165, 0.0, 794.7118000552183], [0.0, 779.5071163774452,
561.3314451453386], [0.0, 0.0, 1.0]])
D=np.array([[-0.042595202508066574], [0.031307765215775184], [-0.04104704724832258],
[0.0153430146057933 24]])
```

## Un-distort images

Once you obtain K and D, follow the steps here to un-distort images if:

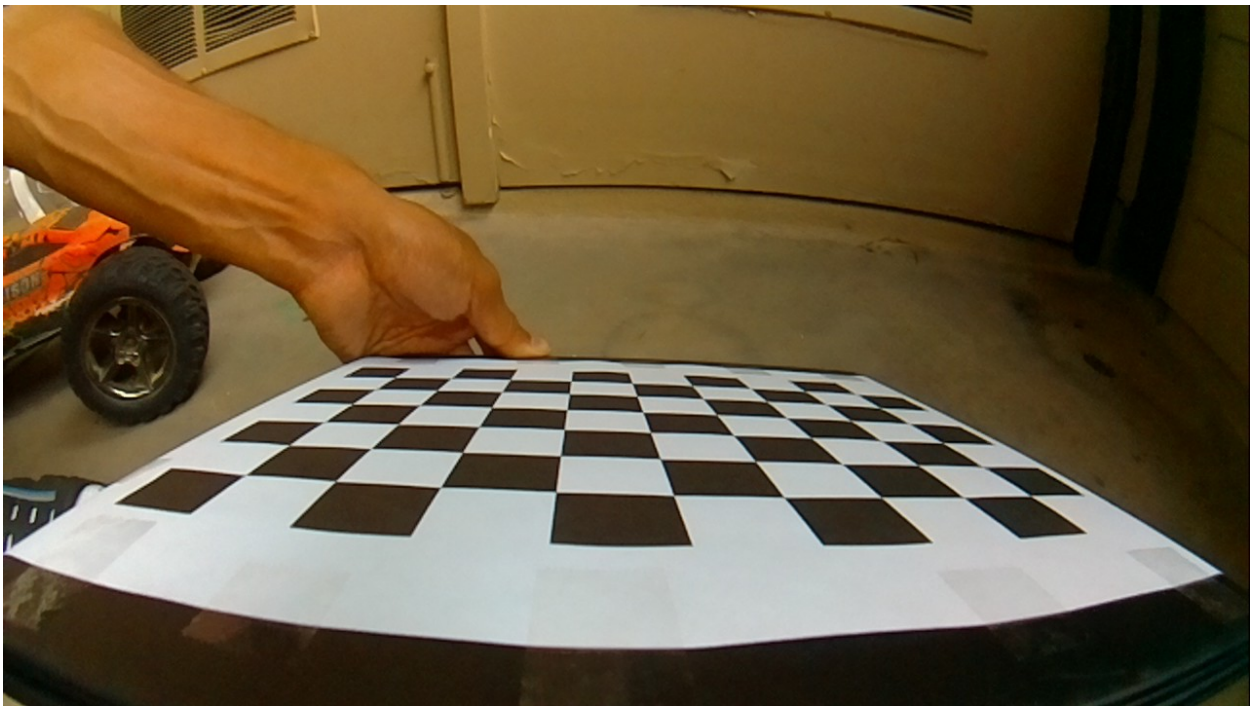
- The images you need to undistort are the same dimension as the ones captured during calibration.
- You are ok with some areas around the edge being cropped out to keep the un-distorted images neat.

Your life will be a lot easier if this is the case. Otherwise you need to followpart 2 of the tutorial.

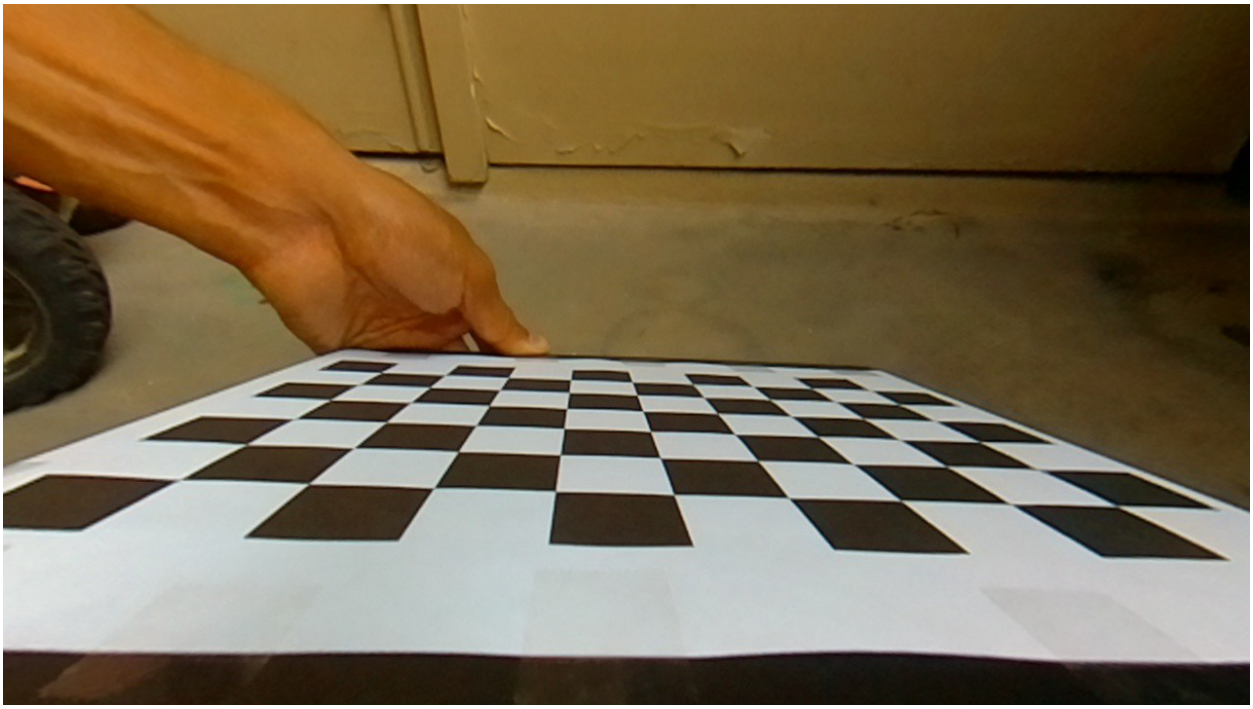
Create file `undistort.py` with the following python code:

```
# You should replace these 3 lines with the output in calibration step
DIM=XXX
K=np.array(YYY)
D=np.array(ZZZ)

def undistort(img_path):

    img = cv2.imread(img_path)
    h,w = img.shape[:2]

    map1, map2 = cv2.fisheye.initUndistortRectifyMap(K, D, np.eye(3), K, DIM,
cv2.CV_16SC2)
    undistorted_img = cv2.remap(img, map1, map2, interpolation=cv2.INTER_LINEAR,
borderMode=cv2.BORDER_CONSTANT)

    cv2.imshow("undistorted", undistorted_img)
    cv2.waitKey(0)
    cv2.destroyAllWindows()

if __name__ == '__main__':
    for p in sys.argv[1:]:
        undistort(p)
```

Now run `python undistort.py file_to_undistort.jpg` and that's it.



**Before**



**After**

If you look closely, you may notice a problem: a significant chunk in the original image gets cropped out in the process. For instance, the orange RC car to the left side of the image only has half a wheel kept in the undistorted image. As a matter of fact about 30% of the pixels in original image get lost. Ouch!

If you want to have a way to get back those lost pixels, continue topart 2 of this tutorial.