CAMERA CALIBRATION WITH OPENCV

1. Project Background and Description

Test camera calibration on different type of images.

2. Data

I used the data included in the OpenCV samples, also the images that I generated by my-self with print of checkerboard and laptop's webcam.

3. Camera Calibration

To calibrate the camera, we need to estabilish correspondences a set of correspondences between 3D world points and 2D image points.

To save the camera calibration results for later use, we need to find nine parameters

Camera Matrix: $\begin{matrix} fx & 0 & Cx \\ 0 & fy & Cy \\ 0 & 0 & 1 \end{matrix}$

Distortion coefficients: (k_1 , k_2, p_1, p_2, k_3)

Where:

f_x, f_y : focal length expressed in pixels

c_x, c_y: coordinates of the so called principal point that should be in the center of the image.

k_1 , k_2, k_3 : Radial distortion

p_1, p_2 : Tangential distortion

4. Evaluating the Accuracy of Single Camera Calibration

Camera calibration is the process of estimating parameters of the camera using images of a special calibration pattern. The parameters include camera intrinsics, distortion coefficients, and camera extrinsics. Once you calibrate a camera, there are several ways to evaluate the accuracy of the estimated parameters:

- Plot the relative locations of the camera and the calibration pattern
  - All the edges should straight.
- Calculate the re-projection errors
  - Re-projection error gives a good estimation of just how exact is the found parameters. This should be as close to zero as possible.
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5. Conclution

What I have done

1. It is importance to set the number of inner corners in the checkerboard
2. Refine the camera matrix based on a free scaling parameter using cv2.**getOptimalNewCameraMatrix**(), so the parameter **alpha** should be set by **value 1** if we don't want to lose any pixel at image corners. But better to check in both case 0 and 1 to choose the best number.
3. Save parameters to txt file then can use later.

What didn't work:

1. Step extract object points and image points for camera calibration not worked well in the yellow light. The white light makes better results.

What should do next:

- It need to check with video from stores with camera in the wide range scale to see how it works.