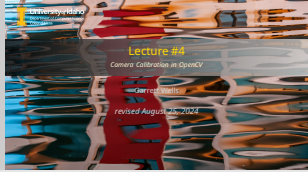

University of Idaho
Department of Computer Science
Coeur d'Alene
Lecture #4
Camera Calibration in OpenCV
Garrett Wells
revised August 25, 2024



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Review

$$x = PX$$

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☞ *translates 3D homogeneous to 4D homogeneous*

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Camera Calibration in OpenCV

Overview

1. **Goal:** find distortion coefficients, intrinsic parameters, extrinsic parameters
   - $(k_1, k_2, p_1, p_2, k_3)$
   - f_x, f_y
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Calibration Patterns

- OpenCV calibration patterns [1]

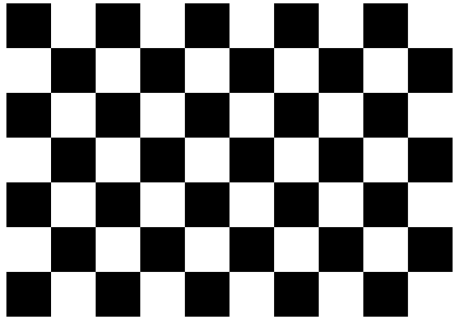


Figure: Chessboard Corners [2]

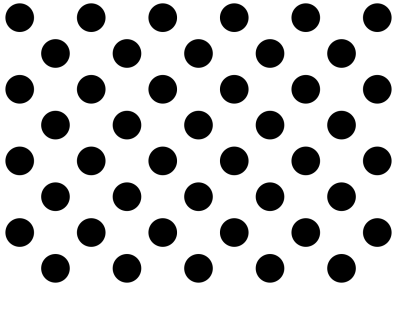
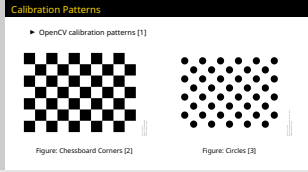


Figure: Circles [3]



1. Note that each calibration pattern includes note(bottom left) describing what the image size should be at $1:1$ scale when used for calibration.
2. The OpenCV tutorial for camera calibration [4], doesn't say much about *why* users might want to use the chessboard pattern over circles. It does say, however, that circles require fewer calibration images to produce good results.

OpenCV Calibration Patterns

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Mounting the Calibration Pattern

8.5”x11” Cardboard! *or any rigid & flat surface*

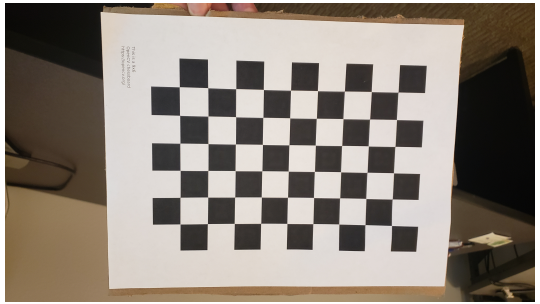

Figure: Example Setup

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1. Use camera to capture multiple images of the calibration pattern.
2. Use OpenCV to get the *image points(2D)* and *object points(3D)*

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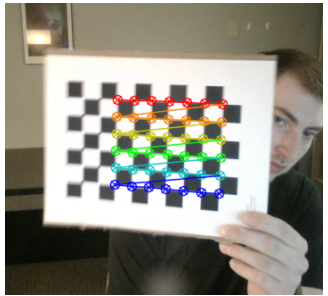
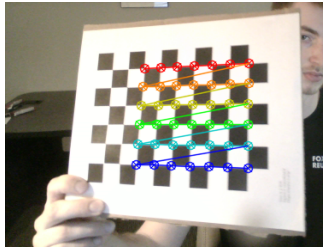
1. Remember, keep the camera **or** the pattern stationary, move the unfixed one between images
2. If using a webcam, likely easiest to have the camera be stationary

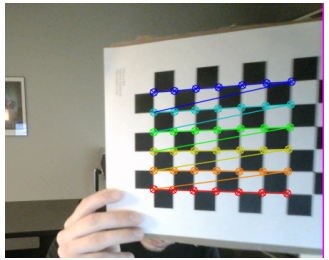
Finding Image Points

Example

```
cv.findChessboardCorners(image, (x_size, y_size), None)
```







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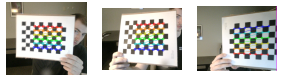

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OpenCV makes this easy, just pass in list of points
Since calibration pattern doesn't change, same points apply to each image

Calibration

Example

```
cv.calibrateCamera(obj_pts, img_pts, ...)
```

- ☞ Returns:
  - ➥ camera matrix (P)
  - ➥ distortion coefficients
  - ➥ rotation params
  - ➥ translation params

Undistorting An Image

The final step…

OpenCV provides two methods for doing this:

- using camera matrix, dist. coefficients, etc, to correct image (easy)
- using remapping (more complex)

1. Remap specifies a pixel location (x, y) to map every input pixel to in the output.

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  - yes

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Assignment #3 Preview

Calibrate a Camera

Use an OpenCV calibration pattern to calibrate your camera.

1. Print out and mount a calibration pattern
2. Obtain 10 images of the pattern using your camera
3. Save your parameters to JSON file
4. Load parameters from file
5. Use them to correct distortion in an image from your camera

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Extra Credit

50-75 pts for building Camera Obscura/Pinhole Camera
Due before December 1st.

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