

22p-9252-lab4

October 6, 2025

```
[1]: import numpy as np  
import cv2
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[2]: def convolution2d(image, kernel):  
    image_h, image_w = image.shape  
    kernel_h, kernel_w = kernel.shape  
    padding_h = (kernel_h - 1) // 2  
    padding_w = (kernel_w - 1) // 2  
    padded_image = np.pad(image, ((padding_h, padding_h), (padding_w, padding_w)), mode='constant', constant_values=0)  
    output = np.zeros((image_h, image_w))  
  
    for i in range(image_h):  
        for j in range(image_w):  
            new = padded_image[i:i+kernel_h, j:j+kernel_w]  
            output[i, j] = np.sum(new * kernel)  
    return output  
  
image = np.random.rand(8, 4)
```

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[3]: image = cv2.imread('chess.png', cv2.IMREAD_GRAYSCALE)
```

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[4]: def guassian_filter2d(sigma):  
    size = int(2 * (np.pi * sigma))  
    if size % 2 == 0:  
        size += 1  
    kernel = np.zeros((size, size))  
    for x in range(size):  
        for y in range(size):  
            kernel[x, y] = (1/(2 * np.pi * sigma**2)) * np.exp(-((x - size//2)**2 + (y - size//2)**2) / (2 * sigma**2))  
    return kernel
```

```
[5]: def harris_corner_detector(img, k):  
    sobel_x = np.array([[-1, 0, 1], [-2, 0, 2], [-1, 0, 1]])  
    sobel_y = np.array([[-1, -2, -1], [0, 0, 0], [1, 2, 1]])
```

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a = convolution2d(img, sobel_x)
b = convolution2d(img, sobel_y)

A = a * a
B = b * b
C = a * b

guass_value = guassian_filter2d(1.5)
guass_A = convolution2d(A, guass_value)
guass_B = convolution2d(B, guass_value)
guass_C = convolution2d(C, guass_value)

# Harris response
R = (guass_A * guass_B - guass_C ** 2) - k * (guass_A + guass_B) ** 2

# Threshold
corners = np.zeros_like(R)
threshold = 0.50 * np.max(R)
corners[R > threshold] = 1

return corners, R

```

[6]: import matplotlib.pyplot as plt

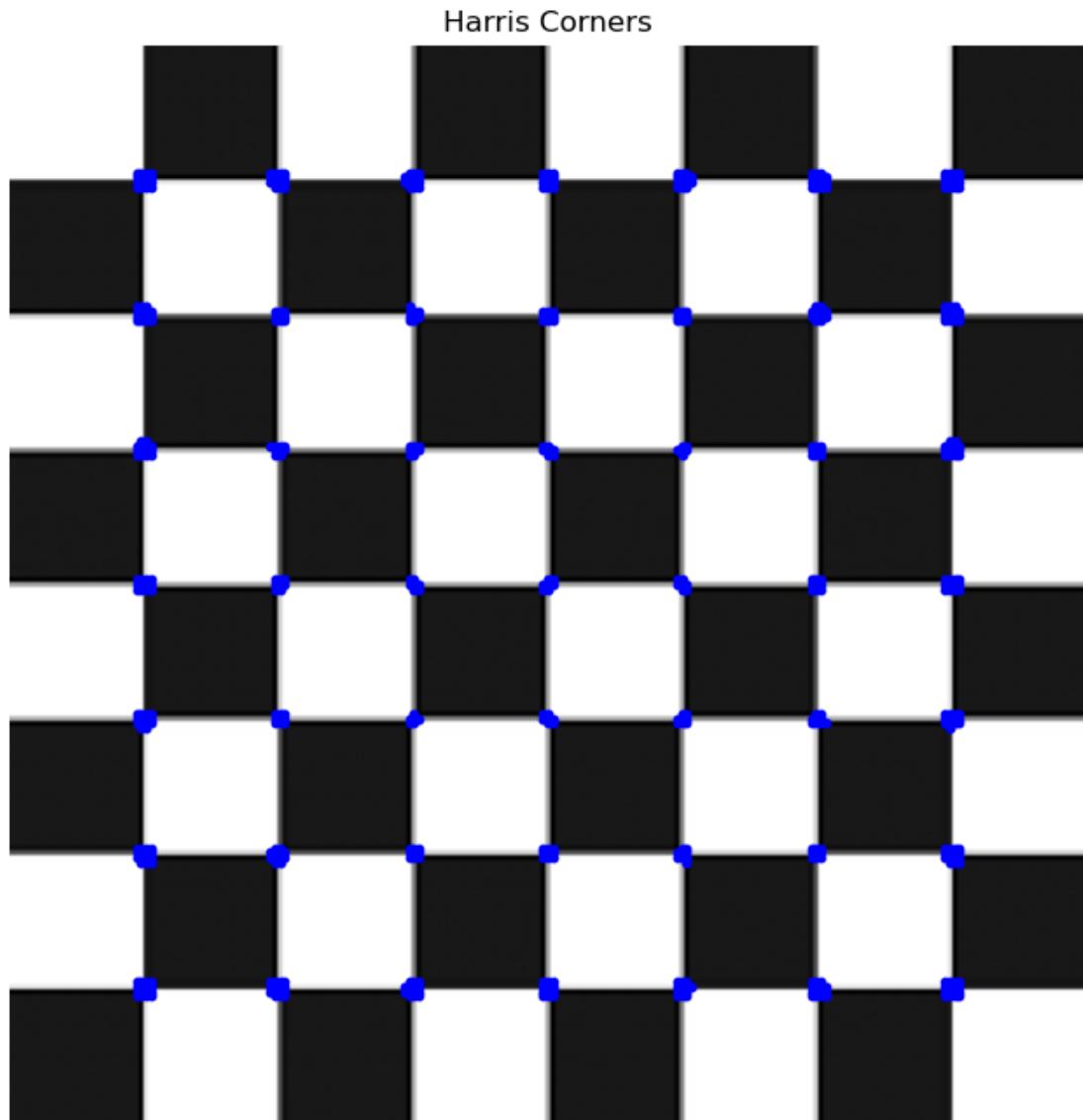
```

corners, R = harris_corner_detector(image, k=0.04)

plt.figure(figsize=(8, 8))
plt.imshow(image, cmap='gray')

y, x = np.where(corners == 1)
plt.scatter(x, y, c='b', s=10)
plt.title('Harris Corners')
plt.axis('off')
plt.show()

```

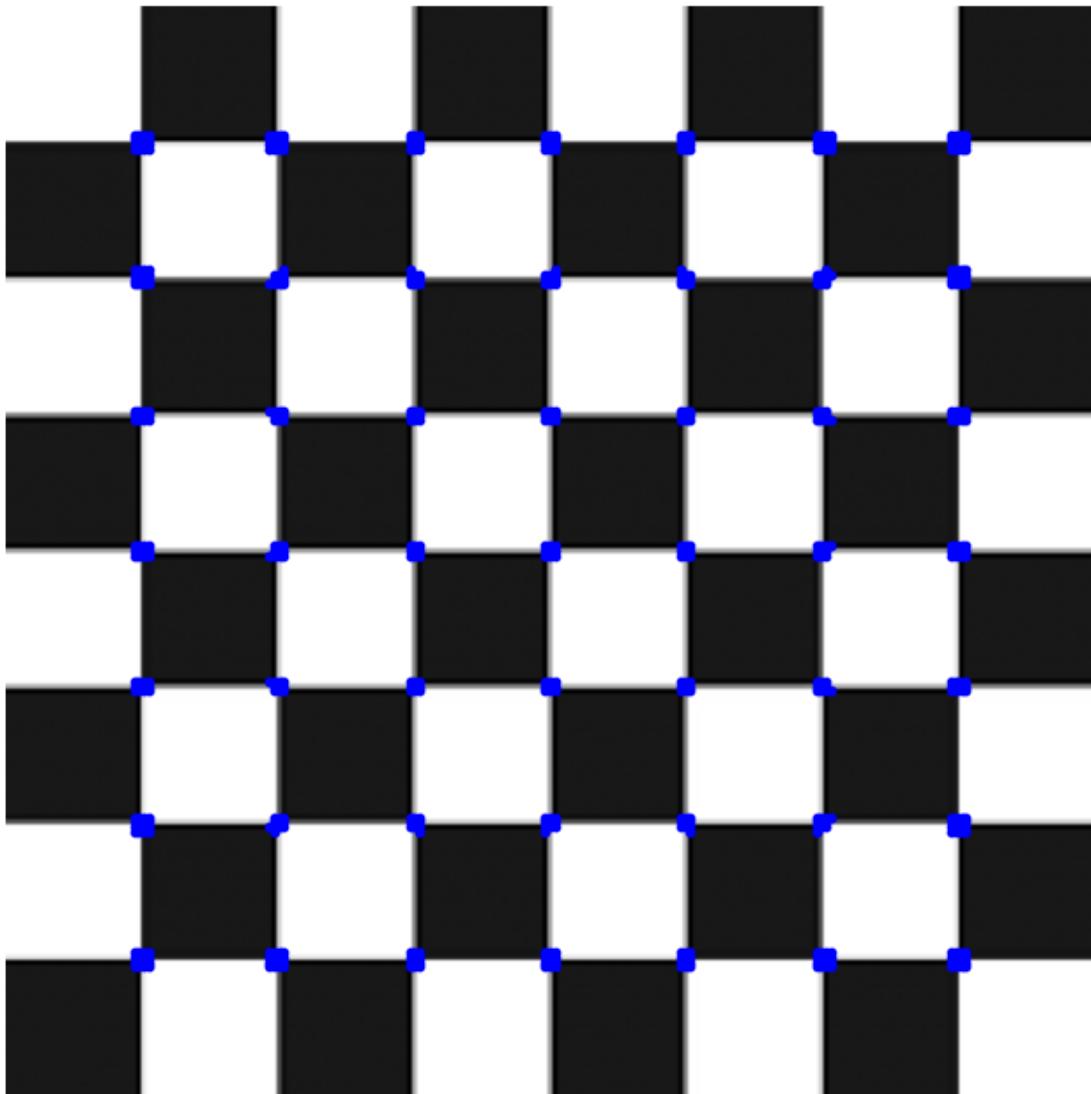


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[7]: b_corners = cv2.cornerHarris(image,3,3,0.04)

threshold = 0.30 * b_corners.max()
y, x = np.where(b_corners > threshold)

plt.figure(figsize=(8, 8))
plt.imshow(image, cmap='gray')
plt.scatter(x, y, c='b', s=10)
plt.title('Harris Corners (OpenCV)')
plt.axis('off')
plt.show()
```

Harris Corners (OpenCV)



```
[29]: def shiTomashi(img):
    sobel_x = np.array([[-1, 0, 1], [-2, 0, 2], [-1, 0, 1]])
    sobel_y = np.array([[-1, -2, -1], [0, 0, 0], [1, 2, 1]])

    a = convolution2d(img, sobel_x)
    b = convolution2d(img, sobel_y)

    A = a * a
    B = b * b
    C = a * b

    guass_value = guassian_filter2d(1.5)
```

```

guass_A = convolution2d(A, guass_value)
guass_B = convolution2d(B, guass_value)
guass_C = convolution2d(C, guass_value)

# Shi-Tomasi (minimum eigenvalue)
R = 0.5 * ((guass_A + guass_B) - np.sqrt((guass_A + guass_B) ** 2 - 4 * (guass_A * guass_B - guass_C ** 2) + 1e-10))

# Threshold
corners = np.zeros_like(R)
threshold = 0.60 * np.max(R)
corners[R > threshold] = 1

return corners, R

```

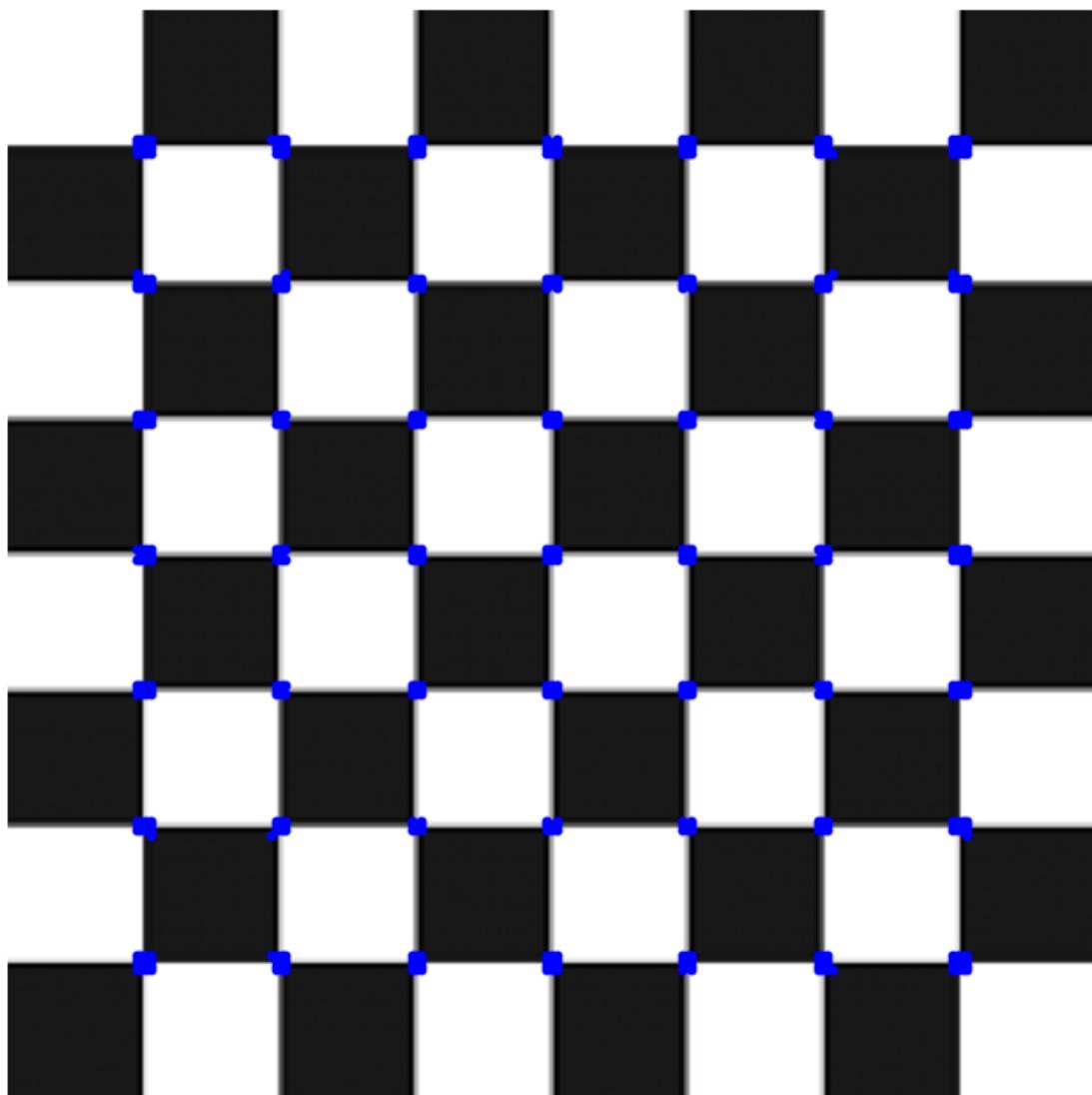
```

[30]: corners, R = shiTomaschi(image)

y, x = np.where(corners == 1)
plt.figure(figsize=(8, 8))
plt.imshow(image, cmap='gray')
plt.scatter(x, y, c='b', s=10)
plt.title('Shi-Tomasi Corner Detection')
plt.axis('off')
plt.show()

```

Shi-Tomasi Corner Detection



[]: