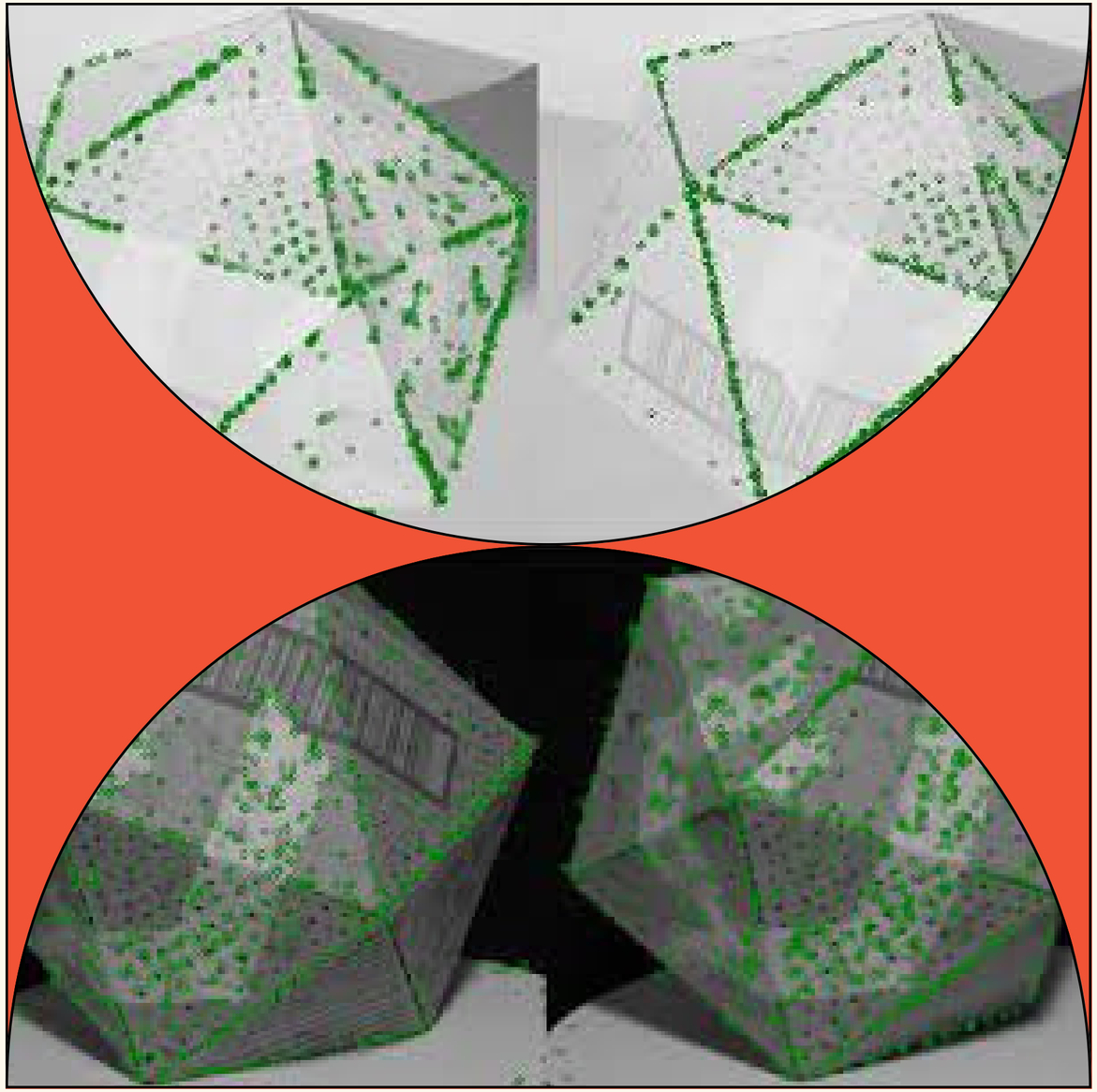
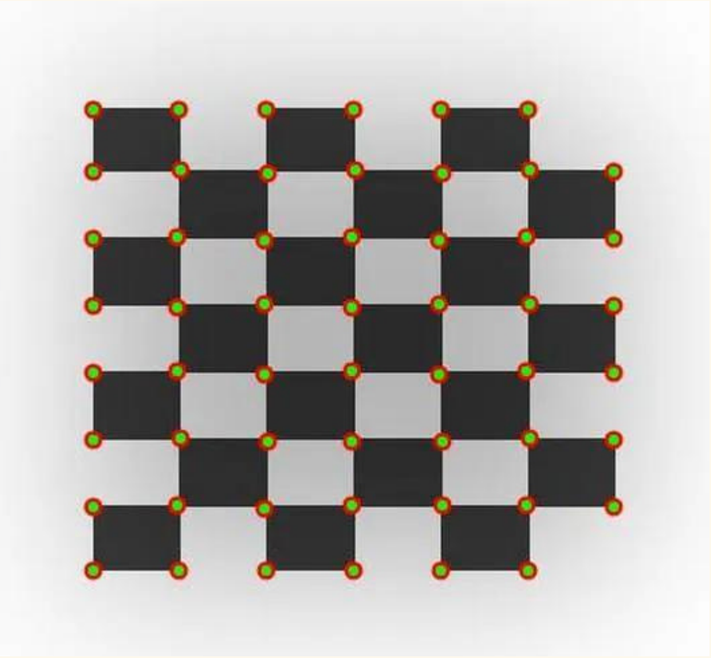


Different forms of Harris Operator.

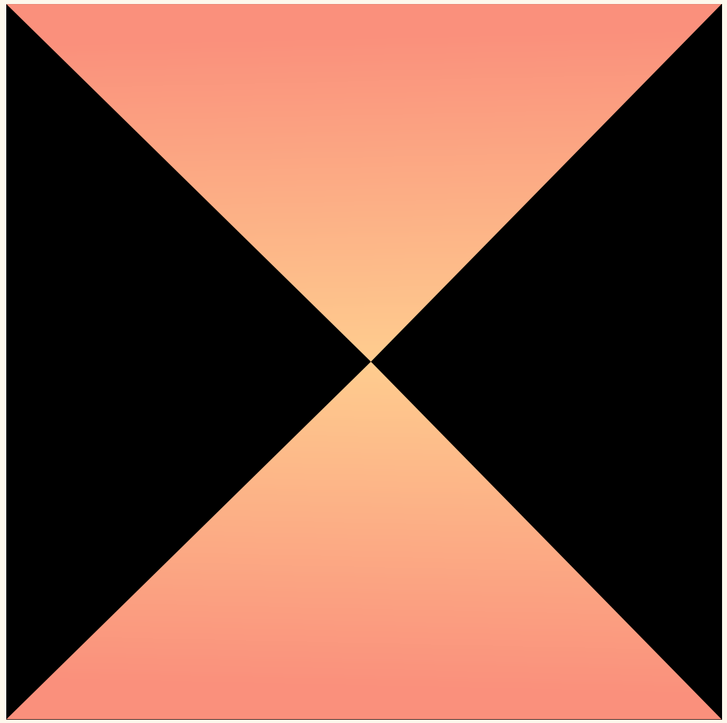
- 60009200013 - ARYAN MEHTA
- 60009200014 - BHAGYA SHAH
- 60009200028 - KESHAV AGARWAL
- 60009200030 - SARVAGYA SINGH

What is Harris Operator ?

- The Harris corner detector is a corner detection operator that is commonly used in computer vision algorithms to extract corners and infer features of an image.
- It was first introduced by Chris Harris and Mike Stephens in 1988 upon the improvement of Moravec's corner detector

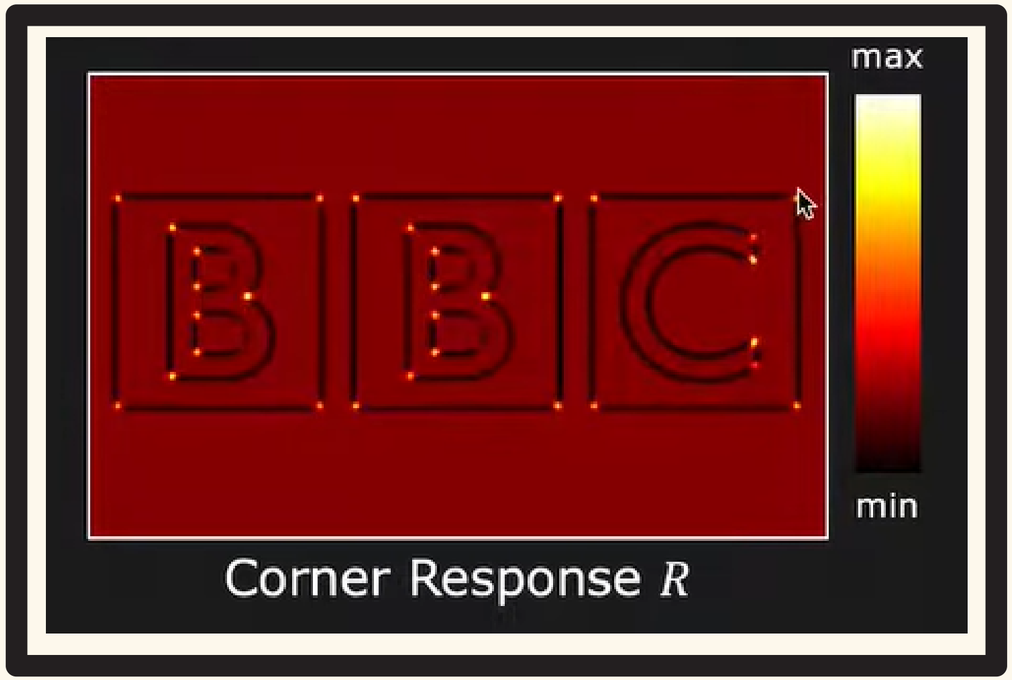


Types of Harris Operator :



1. Standard Harris operator
2. Harris-Stephens operator
3. Noble operator

Standard Harris operator:



The standard Harris operator is defined as:

$$R = \det(M) - k(\text{trace}(M))^2$$

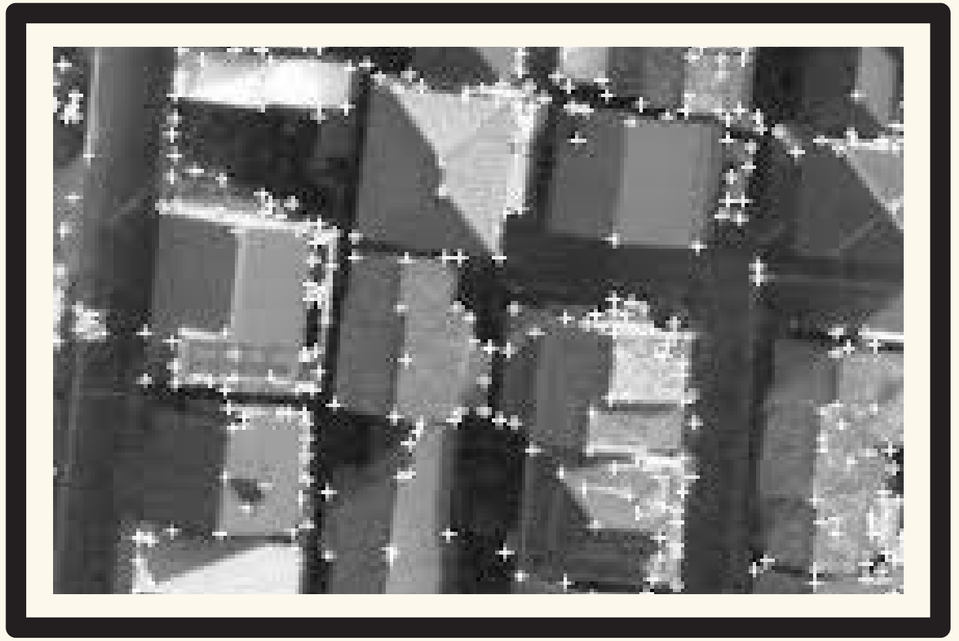
where M is the 2x2 matrix of local image derivatives, k is an empirical constant (usually set to 0.04), det(M) is the determinant of M, and trace(M) is the trace of M.

Harris-Stephens operator:

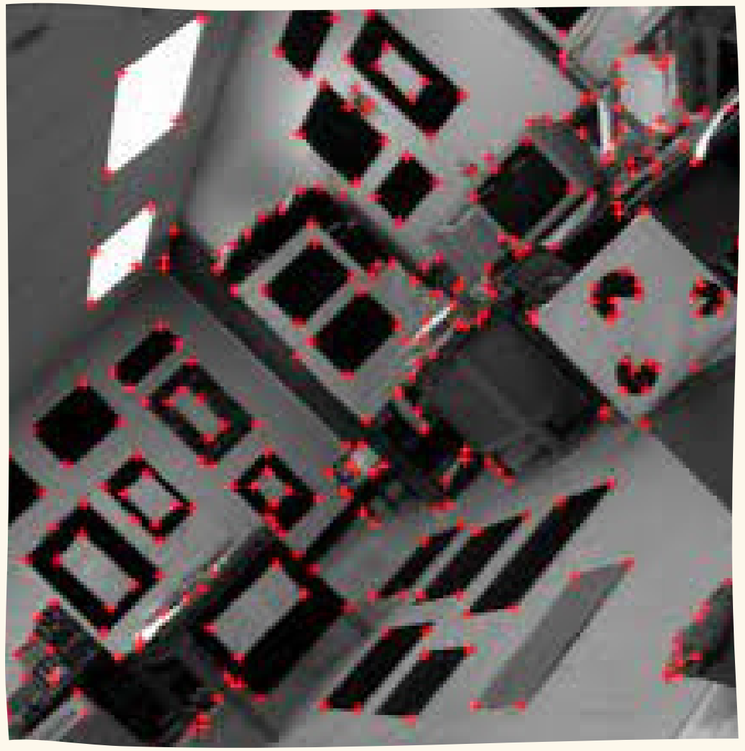
It is a modification of the standard Harris operator that adds a parameter to control the corner response:

$$R = \det(M) / (\text{trace}(M) + \varepsilon)$$

where epsilon is a small positive constant added to the trace to prevent division by zero.



Noble operator



The Noble operator is a modification of the Harris operator that uses the eigenvalues of M to compute the corner response:

$$R = \lambda 1 * \lambda 2 / (\lambda 1 + \lambda 2 + \varepsilon)$$

where λ1 and λ2 are the eigenvalues of M, and epsilon is a small positive constant added to the denominator to prevent division by zero.

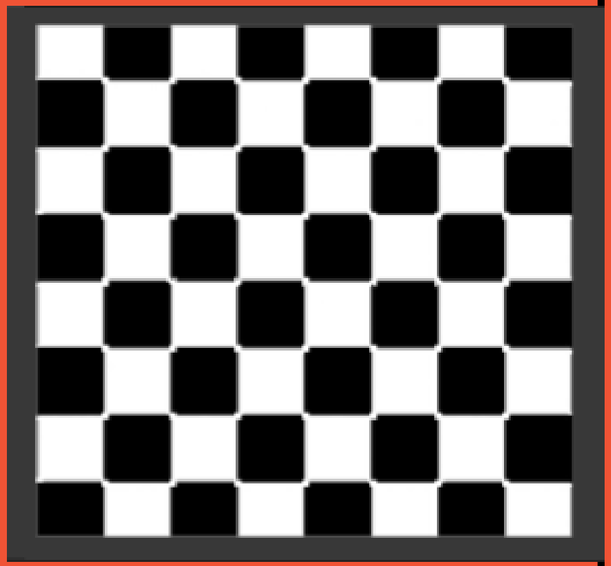
```python
import cv2
import numpy as np
from google.colab.patches import cv2_imshow

img = cv2.imread('images.png', 0)

# Set parameters for Harris corner detector
block_size = 2
aperture_size = 3
k = 0.04

# Calculate Harris response
harris_response = cv2.cornerHarris(img, block_size, aperture_size, k)

# Threshold and display corners
img[harris_response > 0.01 * harris_response.max()] = 255
cv2_imshow(img)
cv2.waitKey(0)
cv2.destroyAllWindows()S
```



Applications of Harris Operator

The Harris operator is commonly used in feature detection for object recognition in images and videos.

It is also used in motion tracking, stereo vision, and image registration.

Limitations of Harris Operator

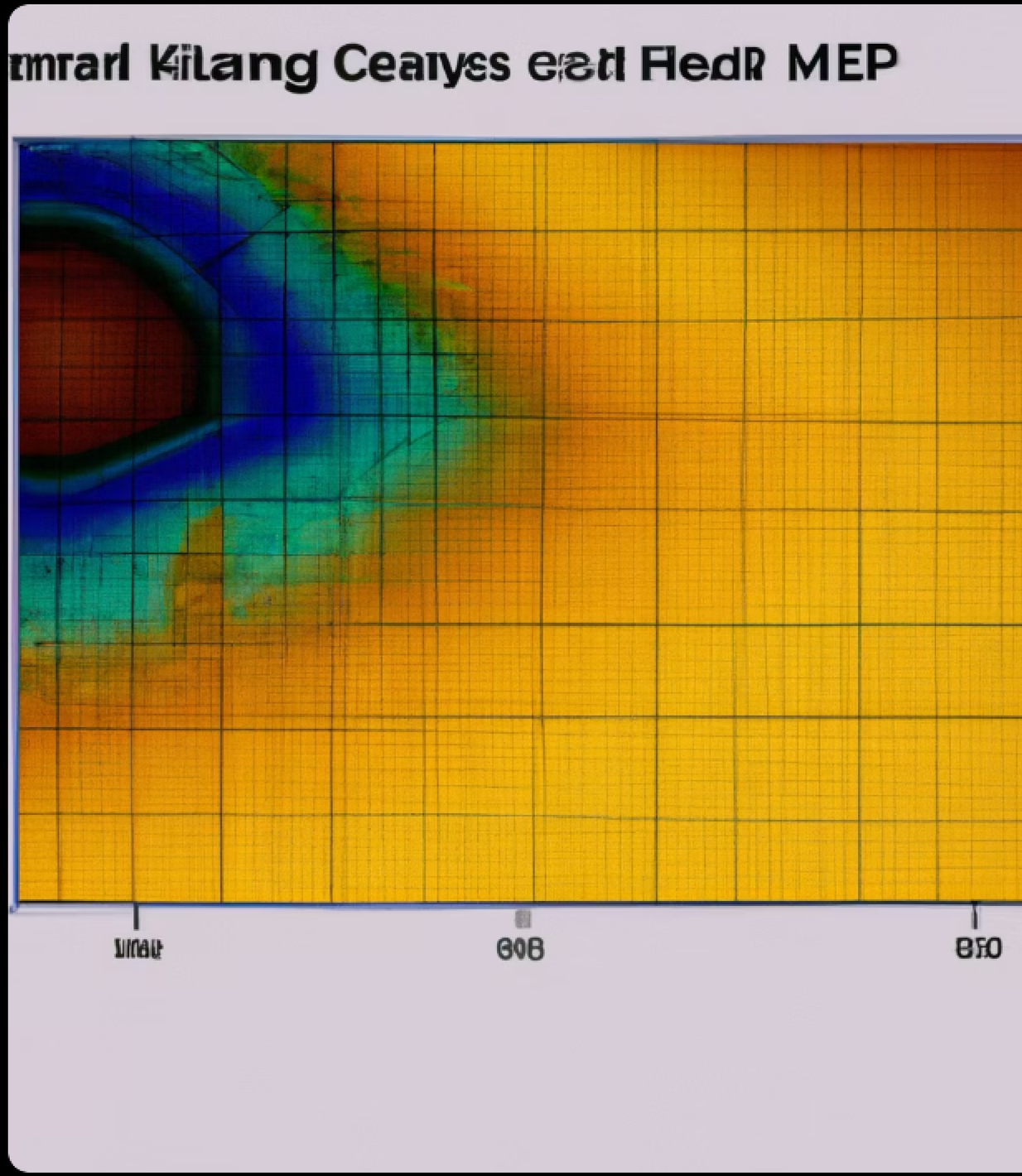
The Harris operator is sensitive to noise and may produce false positives in noisy images.

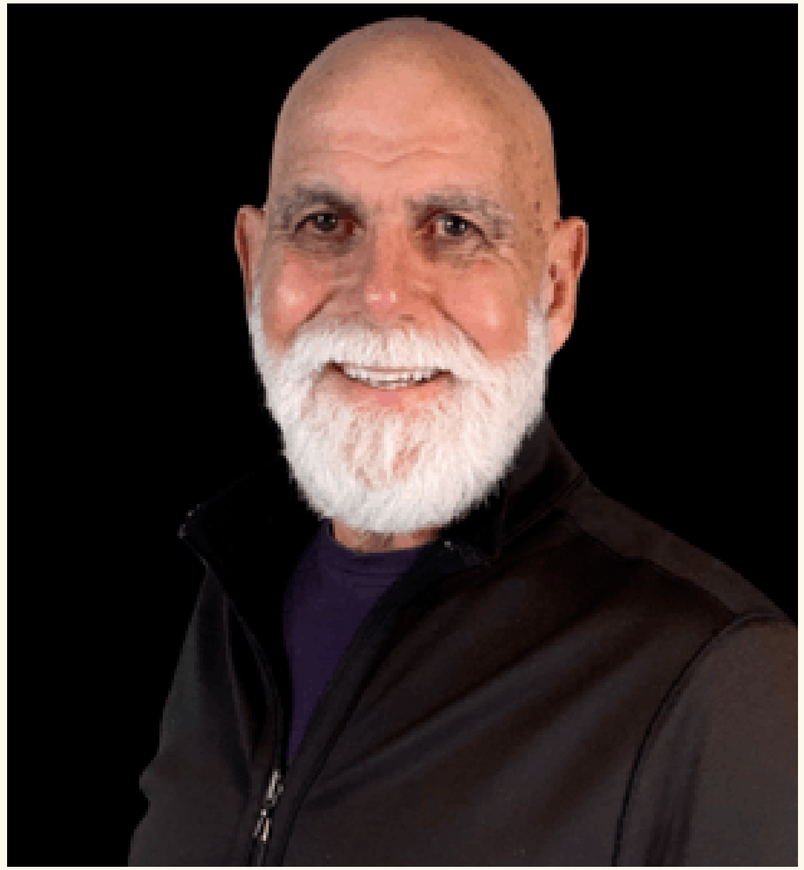
It is also not effective in detecting edges or lines, as it only detects corners.

Conclusion

The Harris operator is a powerful corner detection algorithm with many applications in computer vision and image processing.

While it has some limitations, improvements have been made to address these limitations and improve accuracy.





Chris Harris