

# Homework 1 : Image Formation and Features

## Part 1. Harris Corner Detection

- a. Discuss the results of blurred images and detected edges between different kernel sizes of Gaussian filter.

Kernel size : 5



Kernel size : 10



當 kernel size 越大，因為同時考慮到的點越多，所以做完 Gaussian smooth 後會越模糊

- b. Discuss the difference between 3x3 and 30x30 window sizes of structure tensor. (with Gaussian Blur)

Note: Nms window size = 10

Window size = 3\*3



window size = 30\*30



當 window size 越大的時候，NMS 要考量的 window size 越大，所以局部最大值相較 3\*3 較少，所以最後得到的 corner 數較少

c. Discuss the effect of non-maximal suppression.

找到更精準的 corner，相較原來沒做 NMS 的結果，做完 NMS 後找到的 corner 數明顯少很多，採用的比較參數為

Gaussian kernel size = 10, variance = 5,

window size = 3, kapa = 0.04, Nms window size = 10

沒做 NMS



做 NMS



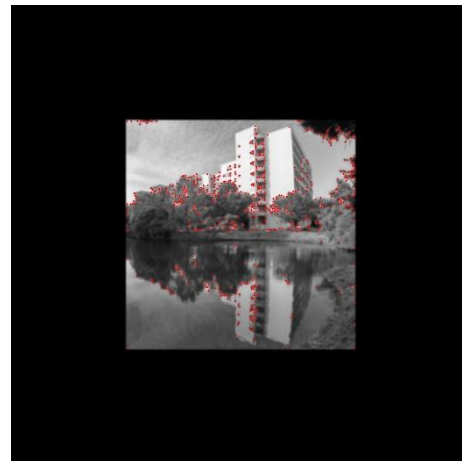
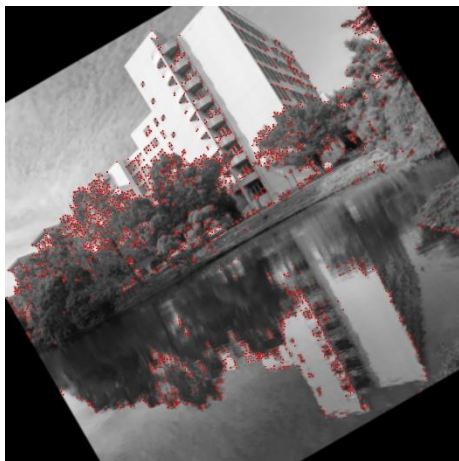
d. Discuss the results of rotated and scaled image.

Is Harris detector rotation-invariant or scale-invariant? Explain the reason. 採用的比較參數為

Gaussian kernel size = 10, variance = 5, nms window size = 10

window size = 3(for structure tensor), kapa = 0.04

左圖為旋轉以後的結果，右圖為縮放以後的結果，就結果而言，有 rotation-invariant，但無 scale-invariant



Harris detector rotation-invariant, 因為都是針對 gradient 來做偵測，就算旋轉或者放大縮小，相對應位置的 gradient 分布仍不變，所以 rotation-invariant. Scale 則會使 gradient 有點變化，所以結果有些不同.

## Part 2. Image Sensing Pipeline (ISP)

- a. Why sensors need to use CFA (Color Filter Array) such as Bayer patterns to store color information? Explain how it works, too.

CFA 得目的是得到 color information，因為感光元件並沒辦法得到 color information 必須透過濾鏡例如 Bayer patterns 得到結果。

利用光透過特殊顏色的濾鏡只能得到該顏色波長的資訊，來獲得原始拍攝物體中的 color information.

- b. Give/Describe two other methods which can perform de-mosaicing and are not mentioned in the slide.

1. Variable Number of Gradients (VNG)
2. Pixel Grouping (PPG)

- c. Show the image results of each step

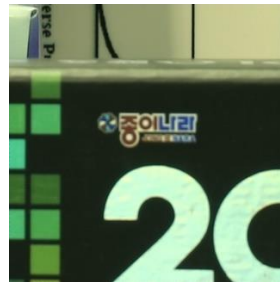
RAW



AWB



Demosaic



Color Correction



CIE XYZ2RGB



Tone Mapping



- d. In recent AI de-noising methods, in order to generate paired data for training, we will add synthetic noise to clean image on RAW domain instead of RGB domain. Explain the reason

因為都沒有經過任何處理手續，所以 RAW 潛在的 noise 比 RGB 少，畢竟在做到 RGB 時已經過多道手續的處理，所以在 RGB 相對 RAW 來說，noise 較多。