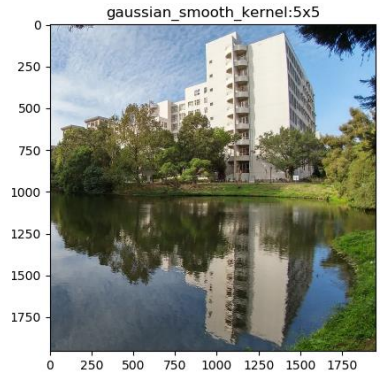
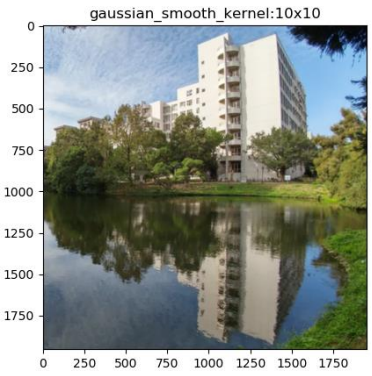
CS655000 Computer Vision Homework 1

108062586 楊子儀

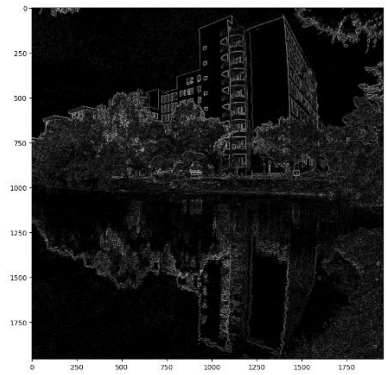
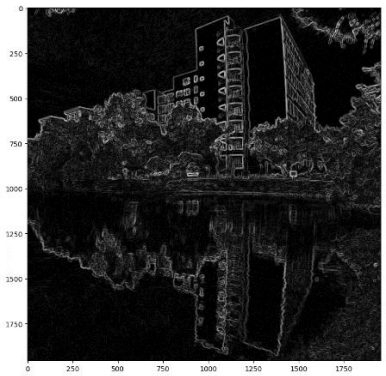
Part 1. Harris Corner Detection

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

Blurred images

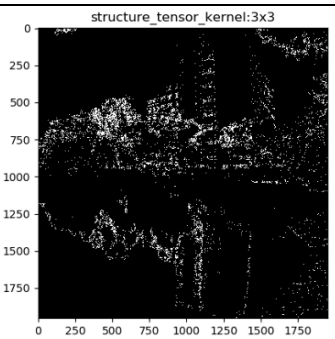
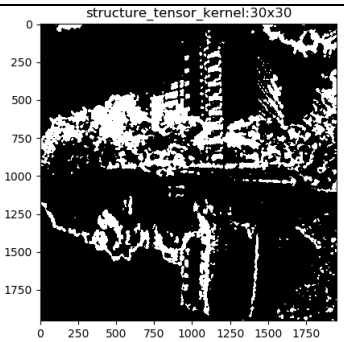
	
Gaussian filter size = 5x5	Gaussian filter size = 10x10

Detected edges

	
Gaussian filter size = 5x5	Gaussian filter size = 10x10

使用不同大小的Gaussian filter size進行Blurred，使用越大的filter會使影像更加模糊；在偵測edge，使用越大的filter會使得到的邊緣線條加粗。

b. Discuss the difference between 3x3 and 30x30 window sizes of structure tensor.

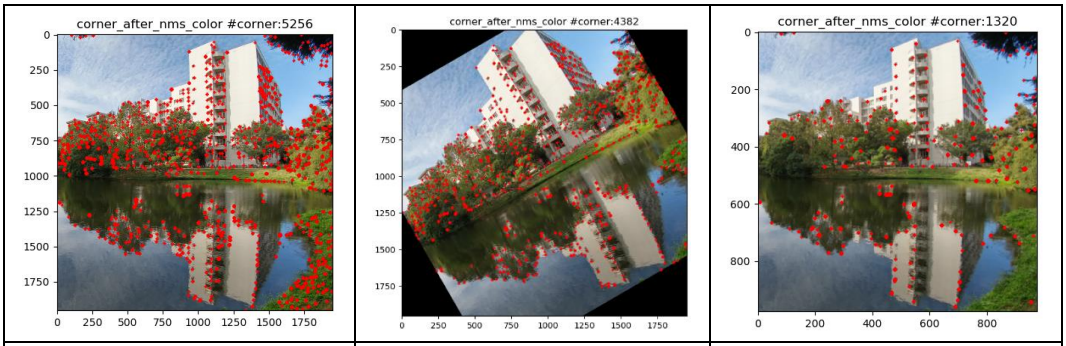
	
3x3 window sizes	30x30 window sizes

使用不同大小的window size做structure tensor，如圖可以發現使用越大size的window，偵測可能為corner的位置會增加，且點的分布為呈現較大點與群聚的樣貌。

c. Discuss the effect of non-maximal suppression.

non-maximal suppression針對判斷corner的R值，使用maximum filter抽取出影像中local maximum的R值，更進一步地篩選出符合角落特徵的地方。

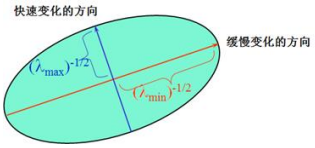
d. Discuss the results of rotated and scaled image. Is Harris detector rotation-invariant or scale-invariant? Explain the reason.



原始影像	旋轉30度	縮放0.5倍

如圖所示，影像旋轉30度後，除了被切除的區域外，最後被偵測為corner的位置並不會改變；而影像縮放0.5倍後，最後被偵測為corner的位置會減少。

Harris detector計算位於的corner附近區域的X和Y方向灰階梯度變化，此階梯度變化可以表示成一個橢圓。當橢圓旋轉時，特徵值並不會發生明顯變化，所以判斷corner的R值也不發生變化，具有rotation-invariant的特性。



Part 2. Image Sensing Pipeline (ISP)

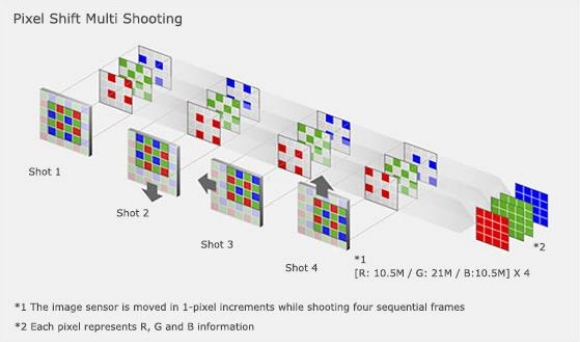
a. Why sensors need to use CFA (Color Filter Array) such as Bayer patterns to store color information? Explain how it works, too.

擷取光訊息的感光元件，獲得的光強度幾乎無法辨別出不同波長的光特異性，無法分離顏色信息，因此需要 CFA。

CFA 將 sensor 感應到不同位置的光強度，使用不同形式的 pattern(ex: bayer patterns)得到該位置顏色的資訊。

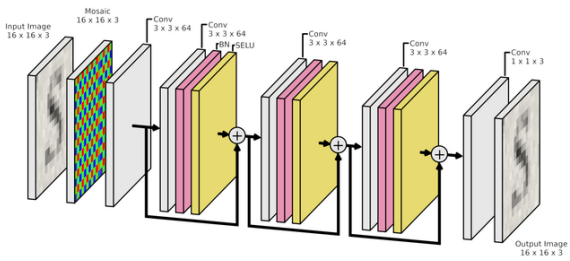
b. Give/Describe two other methods which can perform de-mosaicing and are not mentioned in the slide.

Pixel Shift method:



(https://www.fastrawviewer.com/blog/SonyPixelShift2DNG-converter-Beta)

Deep learning method:



(https://evanfletcher42.com/2018/09/23/arbitrary-learned-mosaic/)

c. Show the image results of each step as p.13-14 in hw1_tutorial.pdf.

		
RAW	AWB	Demosaic
		
Color Correction	CIE XYZ to RGB	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.

彩色影像因為已經過一連串未知的處理過程，在 RGB domain 上對彩色影像做去雜訊，相對於在 RAW domain 上做，可能會額外增加不必要的資訊而影響結果。