Digital Image Processing-Assignment 02

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I. 實驗說明

調整 window size, σ, threshold 參數，觀察是否有改變。

- window size: $3, 5, 7$
- σ: $0.1, 0.3, 0.5, 0.7, 0.9$
- threshold: $20, 30, 40, 50, 60$
- 圖片: lena, headCT

II. 程式碼

```
% read image and convert to grayscale
im = imread('lena.tif');
im(:,:,4) = [];
grayIm = rgb2gray(im);

for  windowSz = 3:2:7
    for sigma = 0.1:0.2:0.5
        for threshold = 0:10:40
            h_filter = Laplacian_mask(windowSz,sigma);
            grayIm2 = filter2(h_filter, grayIm);
            [Gmag,Gdir] = Gradient_magnitude(grayIm2);
            resIm = Zero_crossing(Gmag,Gdir,threshold);
            imwrite(resIm, "lena_" + windowSz + "_" + sigma + "_" + threshold + ".png");
        end
    end
end

% obtain gradient magnitude
function [Gmag,Gdir] = Gradient_magnitude(im)
    [Gmag,Gdir] = imgradient(im,'prewitt');
end

% returns a rotationally symmetric Gaussian lowpass filter
function h = Laplacian_mask(hsize,sigma)
    h = fspecial('gaussian',hsize,sigma);
end

function im = Zero_crossing(Gmag,Gdir,threshold)
    dir = [-1,0 ; 1 0 ; 0 1; 1 0];
    [sz1,sz2] = size(Gmag);
    im = zeros(sz1, sz2);
    for i = 1:sz1
        for j = 1:sz2
            cnt1 = 0; % the number of point has difference > threshold
            cnt2 = 0; % the number of point show different sign with (i,j)
            for k = 1:4
                x = i + dir(k,1);
                y = j + dir(k,2);
                % test if (x,y) is out of boundary
                if x < 1 || x > sz1 || y < 1 || y > sz2
                    continue
                end
                if abs(Gmag(i,j) - Gmag(x,y)) > threshold
                    cnt1 = cnt1 + 1 ;
                end
                if Gdir(i,j) * Gdir(x,y) < 0
                    cnt2 = cnt2 + 1 ;
                end
            end
            if cnt1 >= 1 && cnt2 >= 2
                im(i,j) = 1;
            end
        end
    end
end
```

III. Lena

原圖

Fig. 1. lena

Fig. 3. window size = 3, $\sigma = 0.1$, threshold = 30

越大的 threshold 下，白點會明顯地越少。

Fig. 4. window size = 3, $\sigma = 0.1$, threshold = 40

Fig. 2. window size = 3, $\sigma = 0.1$, threshold = 20

越大的 σ ，邊界的白點會些許的減少。

Fig. 5. window size = 3, $\sigma = 0.3$, threshold = 40

Fig. 6. window size = 3, $\sigma = 0.5$, threshold = 40

Fig. 7. window size = 3, $\sigma = 0.7$, threshold = 40

Fig. 8. window size = 3, $\sigma = 0.9$, threshold = 40

至於調整不同的 window size，則沒有太大的差異。

IV. headCT

原圖

Fig. 9. headCT

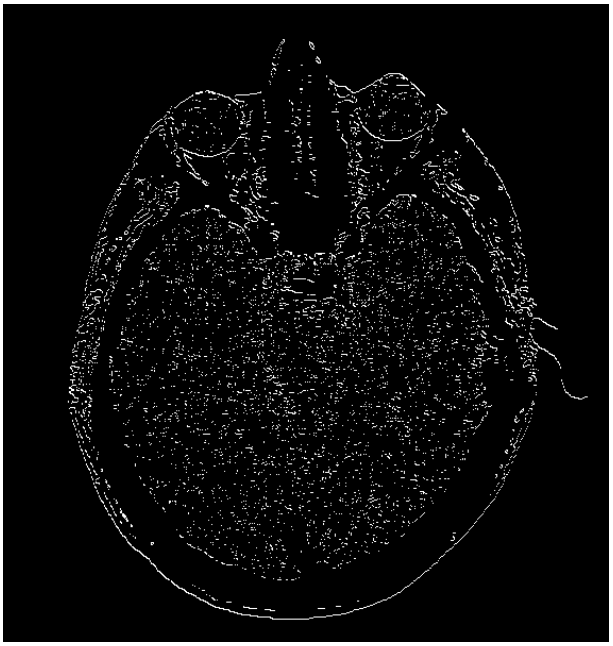

Fig. 11. window size = 3, $\sigma = 0.1$, threshold = 30

headCT 圖片情況和 lena 相同。

不同的 threshold。

Fig. 10. window size = 3, $\sigma = 0.1$, threshold = 20

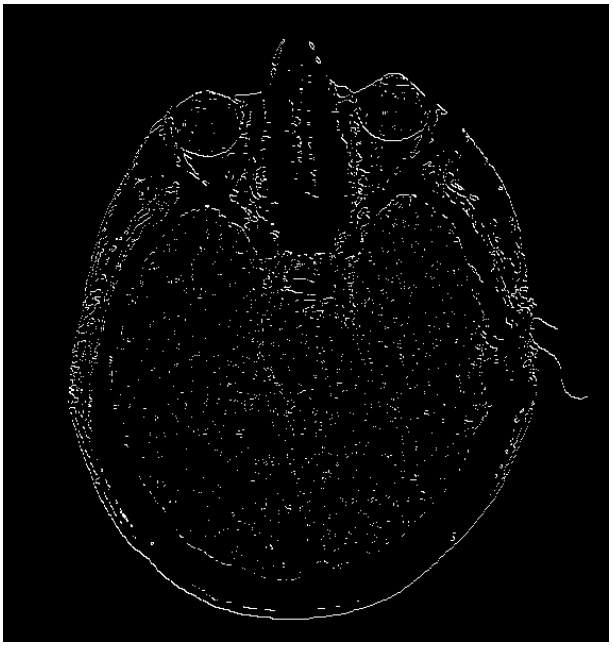

Fig. 12. window size = 3, $\sigma = 0.1$, threshold = 40

不同的 σ。

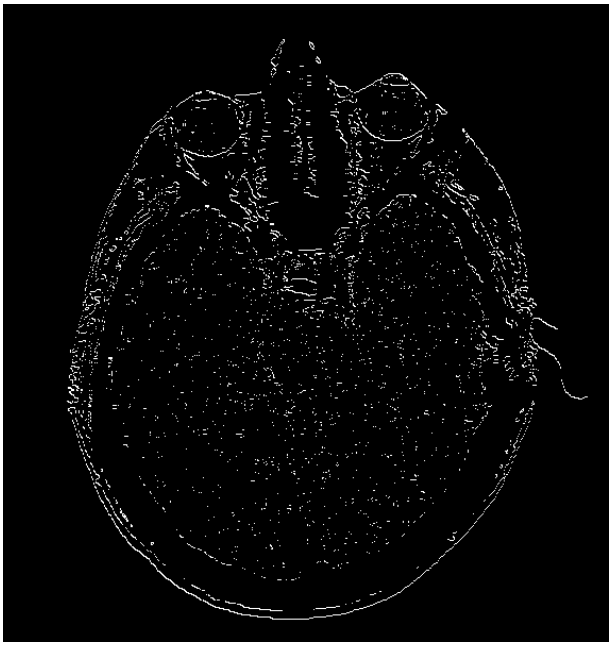

Fig. 13. window size = 3, $\sigma = 0.3$, threshold = 40

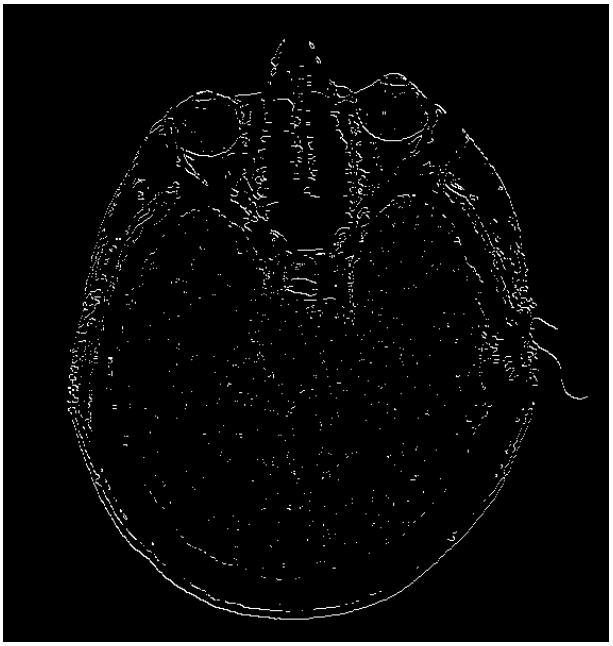

Fig. 14. window size = 3, $\sigma = 0.5$, threshold = 40

Fig. 15. window size = 3, $\sigma = 0.7$, threshold = 40

Fig. 16. window size = 3, $\sigma = 0.9$, threshold = 40