Saturday, February 2, 2019

HW1_ECE 515

1. Download data from blackboard for assignment #1.
2. Using MATLAB with image processing toolbox, perform imread() on the image file "phyllis.png"

- a. What are the dimensions?

  - **Matlab Code**

    ```
    A = imread('phyllis.png');
    [rows, columns, numberOfColorChannels] = size(A);
    ```

  - **Answer**

    The dimensions are [567, 450]. The number of color channel is 1.

- b. What are the minimum and maximum values of the pixel intensities?

  - **Matlab Code**

    ```
    N = max(A);
    M=min(A);
    minimum=min(M);
    maximum=max(N);
    ```

  - **Answer**

    The minimum value is 0 and the maximum value is 255.

- c. What are the intensity values at location (1,1) and (10,10)?

  The intensity value at location (1,1) is 67.

  The intensity value at location (10,10) is 27.

3. Use fspecial to create a 3x3 gaussian filter with sigma=1

- a. Filter the “phyllis.png” image with the gaussian filter and the boundary pixels equal to zero. What is the output intensity at location (1,1) and (10,10)?

  - **Matlab Code**

```
H = fspecial('gaussian',[3 3],1);
A_Gauss = imfilter(A,H);
figure
imshow(A_Gauss);
A_Gauss(1,1)
A_Gauss(10,10)
```

  - **Answer**

    The intensity value at location (1,1) is 29.

    The intensity value at location (10,10) is 26.

- b. Filter the “phyllis.png” image with the gaussian filter and the boundary pixels equal to ‘symmetric’. What is the output intensity at location (1,1) and (10,10)?

  - **Matlab Code**

```
A_symmetric = imfilter(A,H,'symmetric');
figure
imshow(A_symmetric);
A_symmetric(1,1)
A_symmetric(10,10)
```

- **Answer**

  The intensity value at location (1,1) is 59.

  The intensity value at location (10,10) is 26.

- c. Filter the “phyllis.png” image with the gaussian filter and the boundary pixels equal to zero ‘replicate’. What is the output intensity at location (1,1) and (10,10)?

  - **Matlab Code**

    A_replicate = imfilter(A,H,'replicate');

    figure

    imshow(A_replicate);

    A_replicate(1,1)

    A_replicate(10,10)

  - **Answer**

    The intensity value at location (1,1) is 59.

    The intensity value at location (10,10) is 26.

- d. Filter the “phyllis.png” image with the gaussian filter and the boundary pixels equal to ‘circular’. What is the output intensity at location (1,1) and (10,10)?

  - **Matlab Code**

    A_circular = imfilter(A,H,'circular');

    figure

    imshow(A_circular);

    A_circular(1,1)

    A_circular(10,10)

- **Answer**

  The intensity value at location (1,1) is 110.

  The intensity value at location (10,10) is 26.

- e. Compare the results for the four methods. Why are they the same? Why do they differ? Explain.

Intensities at pixel location (1,1) are different, because the location (1,1) is at the edge of matrix. Different padding options will be different.

Intensities at pixel location(10,10) are the same, because the location (10,10) is not at the edge of matrix. Different padding options will be the same.

- f. Which filter method provide the best results at location (1,1)?

The 'symmetric' and 'Replicate' method provide the best result. The intensity value at location (1,1) is 59.

4. Using the following 3x3 filter

$$1/6\begin{bmatrix}1 & 1 & 0\\ 0 & 0 & 1\\ 1 & 1 & 1\end{bmatrix}$$

- a. Filter the "phyllis.png" via correlation with boundary pixels equal to zero. What is the value at location (10,10)?

- **Matlab Code**

```
H1=1/6*[1 1 0;0 0 1;1 1 1];
C = imfilter(A,H1,'corr');
```

```
figure
imshow(C);
C(10,10)
```

- **Answer**

  The intensity value at location (10,10) is 26.

- b. Filter the “phyllis.png” via convolution with boundary pixels equal to zero. What is the value at location (10,10)?

  - **Matlab Code**

```
H1=1/6*[1 1 0;0 0 1;1 1 1];
C = imfilter(A,H1,'conv');
figure
imshow(C);
C(10,10)
```

  - **Answer**

    The intensity value at location (10,10) is 26.

- c. What is the difference in the result? Explain why.

The intensity value at location (10,10) are the same. After filtered by correlation and convolution methods, the matrices are different. Because the kernel for convolution has been flipped.

5. Perform the same operations in #4 with the 3x3 gaussian filter with sigma=1

- a. Filter the “phyllis.png” via correlation with boundary pixels equal to zero. What is the value at location (10,10)?

- **Matlab Code**

```
B = imfilter(A,H,'corr');
figure
imshow(B);
B(10,10)
```

- **Answer**

  The intensity value at location (10,10) is 26.

- b. Filter the “phyllis.png” via convolution with boundary pixels equal to zero. What is the value at location (10,10)?

  - **Matlab Code**

```
B = imfilter(A,H,'corr');
figure
imshow(B);
B(10,10)
```

  - **Answer**

    The intensity value at location (10,10) is 26.

- c. What is the difference in the result? Explain why.

The intensity value at location (10,10) are the same. After filtered by correlation and convolution methods, the matrices are the same. Because the kernel for gaussian method is central symmetrical.

6. Load the image “phyllis_noise.png”

- a. What type of noise do you see in the image?

Salt and pepper noise.

- b. What is the intensity value at pixel location (12,7)?

  The intensity value at location (12,7) is 255.

- c. Perform median filtering on the image via matlab function medfilt2(). How does the output look compared to the original “phyllis.png”? What is the pixel intensity at location (12,7)?

  - **Matlab Code**

```
A_NOISE = imread('phyllis_noise.png');
figure
imshow(A_NOISE);
A_NOISE(12,7)
```

```
K = medfilt2(A_NOISE);
figure
imshow(K);
K(12,7)
```

- **Answer**

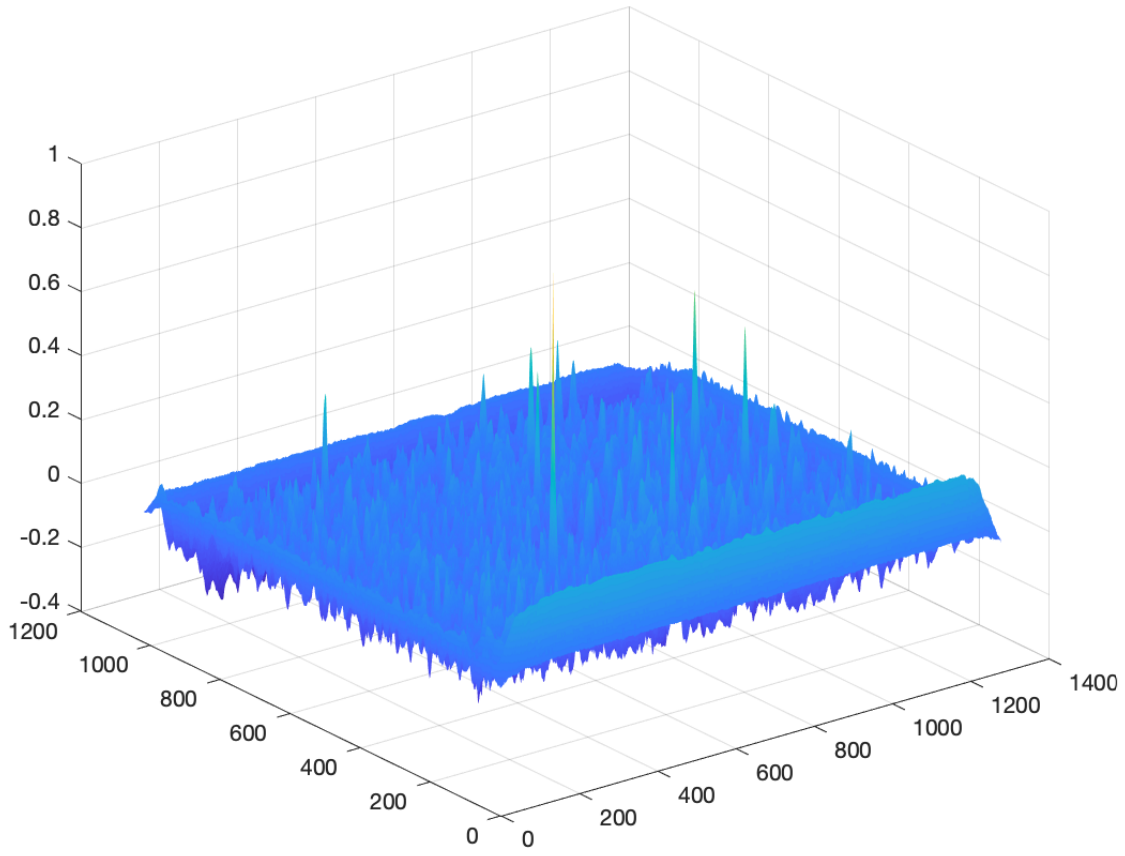
The noise has been reduced. The output look of the new one is the same as the original “phyllis.png”. The intensity value at location (12,7) is 23.

- d. What is the pixel intensity in the original image “phyllis.png” at location (12,7)? How do they compare? Why do they differ?

The intensity value in the original image “phyllis.png” at location (12,7) is 22. The filtered one is more similar to the original one than the noised one. Because the median filter will replace spikes with the median.

7. Load the image “hiero.png” and the template “hiero_t.png”

- a. Perform normalize cross correlation of the image with the template and view with mesh or surf



- b. What (x,y) location produces the highest peak?

  - **Matlab Code**

```
A71 = imread('hiero.png');
A72 = imread('hiero_t.png');
figure
imshow(A71);
figure
imshow(A72);
nor = normxcorr2(A72,A71);
figure, surf(nor), shading flat
[max_c, imax] = max(abs(nor(:)));
[ypeak, xpeak] = ind2sub(size(nor),imax(1));
```

  - **Answer**

    The highest peak is (420,320)

- c. Roughly how many good matches does this template find with correlation threshold >0.75 ?

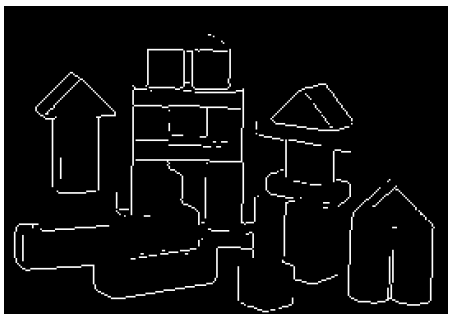
  There are 7 good matches.

8. Load the image “blocks.png”

- a. Perform the edge() function with ‘sobel’ using default parameters

- **Matlab Code**

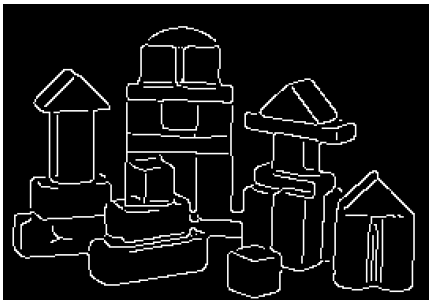
```
blocks = imread('blocks.png');
figure, imshow(blocks);
[BW,thresh]= edge(blocks,'sobel');
figure, imshow(BW);
```



- b. Perform the edge() function with ‘canny’ using default parameters

- **Matlab Code**

```
[BW1,thresh1] = edge(blocks,'canny');
figure, imshow(BW1);
```



- c. Compare the two results (a) and (b). Which one is better? Where does ‘sobel’ have problems? Where does ‘canny’ have problems?

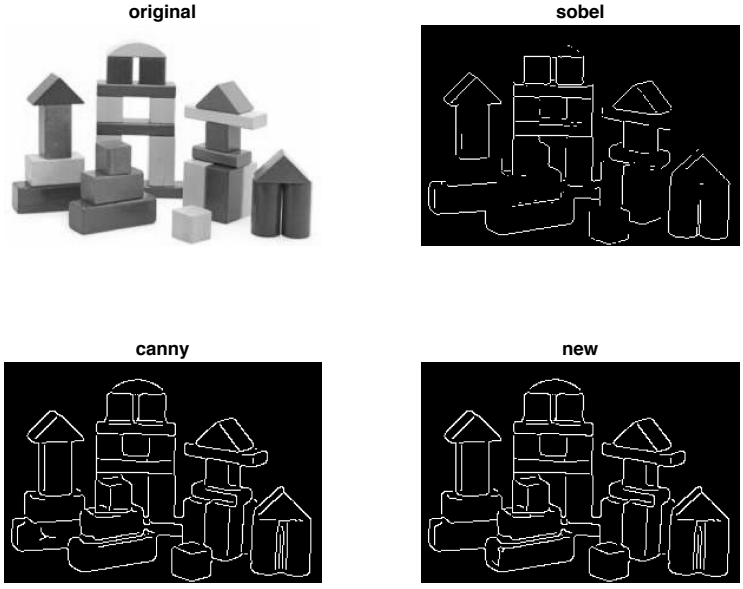
The ‘canny’ method is better. The ‘sobel’ method cannot detect some weak edges. The ‘canny’ method produces some superfluous edges.

- d. What are the default parameters for ‘canny’: Low THRESH, HIGH THRESH, SIGMA? Can you tune the parameters and find better results?

Low thresh : 0.0437500000000000

High thresh : 0.109375000000000
Sigma : The default is sqrt(2).

There is a high threshold for low edge sensitivity and a low threshold for high edge sensitivity in canny method. In the canny image, some weak edges didn’t appear But there are still some superfluous edges. So I tried to decrease the low thresh to 0.015 and increased the high thresh to 0.12. Then I got a better result.



- **Matlab Code**

```
blocks = imread('blocks.png');
[BW1,thresh]= edge(blocks,’sobel');
[BW2,thresh1] = edge(blocks,'canny');
[BW3,t]=edge(blocks,'canny',[0.015,0.12]);
figure(1)
subplot(2,2,1);imshow(blocks),title('original');
subplot(2,2,2);imshow(BW1),title('sobel');
subplot(2,2,3);imshow(BW2),title('canny');
subplot(2,2,4);imshow(BW3),title('new');
```

- e. What are the default parameters for ‘sobel’: THRESH?

  Thresh : 0.116180925949063