Computer Engineering

01CE0507 - Image Processing - Lab Manual

Practical 4

Aim: Write a program to apply various filtering techniques in Matlab.

- > Types of Noise (Gaussian Noise, Poisson noise, Salt & Pepper Noise, Speckle Noise)
 - o Gaussian noise

```
operator_robert.m × noise_gaussian.m × +
       subplot (1,2,1);
          I = imread('cameraman.tif');
3 -
           imshow(I);
 4 -
           title('Original Image');
5 -
      subplot (1,2,2);
 6 -
          J = imnoise(I, 'gaussian');
7 -
           imshow(J);
8 -
           title('Gaussian noise');
9 -
          fprintf('92000103073 Raj Chhadia');
10
```



o Poisson noise

```
operator_robert.m × noise_poisson.m ×
1 -
       subplot (1,2,1);
           I = imread('cameraman.tif');
3 -
           imshow(I);
           title('Original Image');
5 -
      subplot (1,2,2);
6 -
           J = imnoise(I, 'poisson');
           imshow(J);
           title('Poisson noise');
8 -
           fprintf('92000103073 Raj Chhadia');
D
```



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Original Image





o Salt & pepper noise

```
subplot(1,2,1);
    I = imread('cameraman.tif');
    imshow(I);
    title('Original Image');
subplot(1,2,2);
    J = imnoise(I,'salt & pepper');
    imshow(J);
    title('Salt & Pepper noise');
    fprintf('92000103073 Raj Chhadia');
```





Salt & Pepper noise



o Speckle noise

```
subplot(1,2,1);
    I = imread('cameraman.tif');
    imshow(I);
    title('Original Image');
subplot(1,2,2);
    J = imnoise(I,'speckle');
    imshow(J);
    title('Speckle noise');
    fprintf('92000103073 Raj Chhadia');
```



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> Spatial Domain - Low Pass Filters / The Smoothing Spatial Filter

1. Linear Filters / Mean Filter

- a. Averaging Filter / Standard Average Filter / Arithmetic Mean Filter
 - i. N₈(P) Neighbor

```
%N8(P)
I =imread('cameraman.tif');
X = imnoise(I,'salt & pepper');
f=1/9*[1,1,1;1,1,1;1,1,1];

Z=filter2(f,X);
    subplot(1,3,1);
    imshow(I);
    title('Original Image');

subplot(1,3,2);
    imshow(X);
    title('Noisy Image');

subplot(1,3,3);
    imshow(uint8(Z));
    title('Denoised Image');
    fprintf('92000103073 Raj Chhadia');
```

Original Image



Noisy Image



Denoised Image







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ii. N_D(P) Neighbor

```
%ND(P)
I =imread('cameraman.tif');
X = imnoise(I,'salt & pepper');
f=1/9*[1,0,1;0,1,0;1,0,1];
Z=filter2(f,X);
   subplot (1, 3, 1);
    imshow(I);
   title('Original Image');
subplot (1, 3, 2);
    imshow(X);
    title('Noisy Image');
subplot (1, 3, 3);
   imshow(uint8(Z));
    title('Denoised Image');
   fprintf('92000103073 Raj Chhadia');
```







iii. N₄(P) Neighbor

```
%N4 (P)
I =imread('cameraman.tif');
X = imnoise(I,'salt & pepper');
f=1/9*[0,1,0;1,1,1;0,1,0];
Z=filter2(f,X);
    subplot (1, 3, 1);
    imshow(I);
    title('Original Image');
subplot (1, 3, 2);
    imshow(X);
    title('Noisy Image');
subplot (1, 3, 3);
   imshow(uint8(Z));
    title('Denoised Image');
    fprintf('92000103073 Raj Chhadia');
```







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b. Weighted Averaging Filter / Gaussian Filter

```
fprintf('92000103073 Raj Chhadia');
I =imread('cameraman.tif');
X =imnoise(I,'gaussian');
f =1/16*[1,2,1;2,4,2;1,2,1];
Z =filter2(f,X);
figure;
subplot (1, 3, 1);
imshow(I);
title('Original image');
subplot (1, 3, 2);
imshow(X);
title('Noisy image');
subplot (1, 3, 3);
imshow(uint8(Z));
title('Denoised image');
```

Original image



Noisy image



Denoised image



c. Geometric Mean

```
filter_geometric.m × +
1 - fprintf('92000103073 Raj Chhadia');
                                                                        18 -
                                                                               fl= exp(imfilter(log(NI1),f,'replicate')).^(1/9);
2 -
      I =imread('circuit.tif');
                                                                        19 -
                                                                               imshow(fl):
3 -
     NI = imnoise(I,'salt & pepper');
                                                                        20 -
                                                                              title('Geometric Mean SAP Filter');
4 -
     NI1 = im2double(NI);
                                                                        21
5 -
     NL = imnoise(I, 'gaussian');
                                                                        22
6 -
      NL1 = im2double(NL);
                                                                        23 -
                                                                              subplot (2, 3, 4);
      f=[1,1,1;1,1,1;1,1,1];
                                                                        24 -
                                                                               imshow(I);
                                                                        25 -
                                                                              title('Original Image');
9 -
     subplot (2,3,1);
                                                                        26
10 -
     imshow(I);
                                                                        27 -
                                                                              subplot (2, 3, 5);
11 -
     title('Original Image');
                                                                        28 -
                                                                              imshow(NL);
12
                                                                        29 -
                                                                              title('Noisy Image');
13 -
     subplot (2,3,2);
                                                                        30
14 -
      imshow(NI);
                                                                        31 -
                                                                               subplot (2, 3, 6);
15 -
      title('Noisy Image');
                                                                        32 -
                                                                              f2= exp(imfilter(log(NLl),f,'replicate')).^(1/9);
16
                                                                        33 -
17 -
     subplot (2,3,3);
                                                                        34 -
                                                                               title('Geometric Mean Gaussian Filter');
```



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Original Image



Original Image



Noisy Image





Geometric Mean SAP Filter



Geometric Mean Gaussian Filter



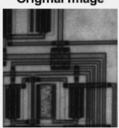
d. Harmonic Mean

```
fprintf('92000103073 Raj Chhadia');
I =imread('circuit.tif');
NI = imnoise(I, 'salt & pepper');
NI1 = im2double(NI);
NL = imnoise(I,'gaussian');
NL1 = im2double(NL);
f=[1,1,1;1,1,1;1,1,1];
subplot (2,3,1);
imshow(I);
title('Original Image');
subplot (2,3,2);
imshow(NI);
title('Noisy Image');
```

subplot (2,3,3);

18 fl= 3*3./imfilter(1./(NI1+eps),f,'replicate'); 19 imshow(fl); 20 title('Harmonic Mean SAP Filter'); 21 22 23 subplot (2, 3, 4); 24 imshow(I); 25 title('Original Image'); 26 27 subplot (2, 3, 5); 28 imshow (NL); 29 title('Noisy Image'); 30 31 subplot (2, 3, 6); 32 f2= 3*3./imfilter(1./(NLl+eps),f,'replicate'); title('Harmonic Mean Gaussian Filter');

Original Image



Original Image



Noisy Image



Noisy Image



Harmonic Mean SAP Filter



Harmonic Mean Gaussian Filter

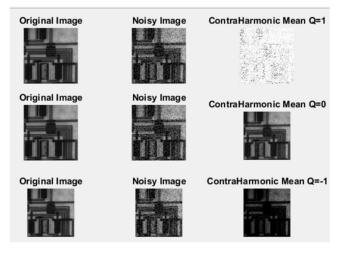


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e. Contraharmonic Mean

i. Using gaussian noise

```
fprintf('92000103073 Raj Chhadia');
                                                                        24
I =imread('circuit.tif');
                                                                        25 -
                                                                                subplot (3, 3, 5);
NI = imnoise(I,'gaussian');
NI1 = im2double(NI);
                                                                        26 -
                                                                                imshow(NI);
                                                                        27 -
                                                                                title('Noisy Image');
f=[1,1,1;1,1,1;1,1,1];
                                                                        28
                                                                        29 -
                                                                                subplot (3, 3, 6);
subplot (3,3,1);
                                                                        30 -
                                                                                f2=imfilter(NI1.^(0+1),f,'replicate');
imshow(I);
                                                                                f3= f2./(imfilter(NI1.^0,f,'replicate')+eps);
                                                                        31 -
title('Original Image');
                                                                        32 -
                                                                                imshow(f3);
                                                                        33 -
                                                                                title('ContraHarmonic Mean Q=0');
subplot (3,3,2);
                                                                        34
                                                                        35 -
                                                                                subplot (3, 3, 7);
title('Noisy Image');
                                                                        36 -
                                                                                imshow(I);
                                                                        37 -
                                                                                title('Original Image');
subplot (3,3,3);
                                                                        38
c2=imfilter(NI1.^(l+1),f,'replicate');
                                                                        39 -
c3= f2./(imfilter(NI1.^1,f,'replicate')+eps);
                                                                        40 -
                                                                                imshow(NI);
                                                                        41 -
                                                                                title('Noisy Image');
title ('ContraHarmonic Mean Q=1');
                                                                        42
                                                                        43 -
                                                                                subplot (3, 3, 9);
subplot (3, 3, 4);
                                                                                b2=imfilter(NI1.^(-1+1),f,'replicate');
imshow(I);
                                                                        45 -
                                                                                b3= f2./(imfilter(NI1.^-1,f,'replicate')+eps);
title('Original Image');
                                                                                imshow(b3);
```



ii. Using salt & pepper noise

```
fprintf('92000103073 Raj Chhadia');
                                                                       25 -
                                                                               subplot (3, 3, 5);
I =imread('circuit.tif');
                                                                      26 -
                                                                               imshow(NI);
NI = imnoise(I, 'salt & pepper');
                                                                      27 -
                                                                              title('Noisy Image');
NI1 = im2double(NI);
                                                                      28
f=[1,1,1;1,1,1;1,1,1];
                                                                      29 -
                                                                               subplot (3, 3, 6);
                                                                      30 -
                                                                              f2=imfilter(NI1.^(0+1),f,'replicate');
subplot (3, 3, 1);
                                                                      31 -
                                                                              f3= f2./(imfilter(NI1.^0,f,'replicate')+eps);
imshow(I);
                                                                       32 -
                                                                              imshow(f3);
title('Original Image');
                                                                      33 -
                                                                              title('ContraHarmonic Mean Q=0');
                                                                       34
subplot (3,3,2);
                                                                       35 -
                                                                               subplot (3,3,7);
imshow(NI);
                                                                       36 -
                                                                               imshow(I);
title('Noisy Image');
                                                                      37 -
                                                                               title('Original Image');
                                                                       38
                                                                       39 -
                                                                               subplot (3, 3, 8);
c2=imfilter(NI1.^(1+1),f,'replicate');
                                                                       40 -
                                                                              imshow(NI);
c3= c2./(imfilter(NI1.^1,f,'replicate')+eps);
                                                                       41 -
                                                                              title('Noisy Image');
imshow(c3);
                                                                       42
title('ContraHarmonic Mean Q=1');
                                                                       43 -
                                                                               subplot (3, 3, 9);
                                                                      44 -
                                                                              b2=imfilter(NI1.^(-1+1),f,'replicate');
subplot (3, 3, 4);
                                                                       45 -
46 -
                                                                               b3= f2./(imfilter(NI1.^-1,f,'replicate')+eps);
imshow(I);
                                                                              imshow(b3);
title('Original Image');
                                                                               title('ContraHarmonic Mean Q=-1');
```



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2. Non-Linear Filters / Order Statistics Filter

a. Median Filtering

```
fprintf('92000103073 Raj Chhadia');
I =imread('cameraman.tif');
    NI = imnoise(I,'salt & pepper');
    &NIl = im2double(NI);
    f=[1,1,1;1,1,1,1];

subplot(1,3,1);
imshow(I);
title('Original Image');

subplot(1,3,2);
imshow(NI);
title('Noisy Image');

subplot(1,3,3);
c2=ordfilt2(NI,5,f);
imshow(c2);
title('Median Filter');
```







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b. Max Filtering

```
fprintf('92000103073 Raj Chhadia');
I =imread('cameraman.tif');
    NI = imnoise(I,'salt & pepper');
    %NI1 = im2double(NI);
    f=[1,1,1;1,1,1;1,1];

subplot(1,3,1);
imshow(I);
title('Original Image');

subplot(1,3,2);
imshow(NI);
title('Noisy Image');

subplot(1,3,3);
c2=ordfilt2(NI,9,f);
imshow(c2);
title('Max Filter');
```

Original Image



Noisy Image



Max Filter



c. Min Filtering

```
fprintf('92000103073 Raj Chhadia');
I =imread('cameraman.tif');
    NI = imnoise(I, 'salt & pepper');
    &NIl = im2double(NI);
    f=[1,1,1;1,1,1;1,1];

subplot(1,3,1);
imshow(I);
title('Original Image');

subplot(1,3,2);
imshow(NI);
title('Noisy Image');

subplot(1,3,3);
c2=ordfilt2(NI,1,f);
imshow(c2);
title('Min Filter');
```

Original Image



Noisy Image



Min Filter





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d. Mid-point Filtering

```
fprintf('92000103073 Raj Chhadia');
I =imread('cameraman.tif');
        NI = imnoise(I, 'salt & pepper');
        %NI1 = im2double(NI);
      f=[1,1,1;1,1,1;1,1,1];
subplot (1, 3, 1);
imshow(I);
title('Original Image');
subplot (1, 3, 2);
imshow(NI);
title('Noisy Image');
subplot (1, 3, 3);
c2=ordfilt2(NI,1,f);
c3=ordfilt2(NI,9,f);
G=imlincomb(0.5,c2,0.5,c3);
imshow(c2);
title('Midpoint Filter');
```

Original Image



Noisy Image



Midpoint Filter

