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Universal Image Quality Index

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% DSP PROJECT : UNIVERSAL IMAGE QUALITY INDEX

clc;            % Clear Command window
clearvars;      % Clear all variables
close all;      % close all Figures and Plots

x = double(imread('OrigLena.gif'));         % comments
h1 = double(imread('Meanshiftlena.gif'));
Q1 = UIQI(x, h1);
[MSE1,PSNR1] = msepsnr(x,h1);       % PSNR
figure;
display(['MEAN SHIFT LENA IMAGE - ','Q = ',num2str(Q1),'  MSE =
 ',num2str(MSE1)]);
subplot(2,2,1);
imshow(uint8(x));
title('Original Image');
subplot(2,2,2);
imshow(uint8(h1));              % comments
title('Mean shift lena image');

h4 = double(imread('Contraststretchinglena.gif'));
Q4 = UIQI(x, h4);
[MSE4,PSNR4] = msepsnr(x,h4);
display(['CONTRAST STRETCHING LENA IMAGE - ','Q = ',num2str(Q4),'  MSE
 = ',num2str(MSE4)]);
subplot(2,2,3);
imshow(uint8(x));
title('Original Image');
subplot(2,2,4);
imshow(uint8(h4));
title('Contrast stretching lena image');


h7 = double(imread('saltpepperlena.gif'));
Q7 = UIQI(x, h7);
[MSE7,PSNR7] = msepsnr(x,h7);
figure;
```

```
display(['SALT PEPPER LENA IMAGE - ','Q = ',num2str(Q7),'  MSE =
 ',num2str(MSE7)]);
subplot(2,2,1);
imshow(uint8(x));
title('Original Image');
subplot(2,2,2);
imshow(uint8(h7));
title('Salt pepper lena image');

h6 = double(imread('Multipliedspecklelena.gif'));
Q6 = UIQI(x, h6);
[MSE6,PSNR6] = msepsnr(x,h6);
display(['MULTIPLIED SPECKLE LENA IMAGE - ','Q = ',num2str(Q6),'  MSE
 = ',num2str(MSE6)]);
subplot(2,2,3);
imshow(uint8(x));
title('Original Image');
subplot(2,2,4);
imshow(uint8(h6));
title('Multiplied speckle lena image');

h3 = double(imread('Additivegaussianlena.gif'));
Q3 = UIQI(x, h3);
[MSE3,PSNR3] = msepsnr(x,h3);
figure;
display(['ADDITIVE GAUSSIAN LENA IMAGE - ','Q = ',num2str(Q3),'  MSE =
 ',num2str(MSE3)]);
subplot(2,2,1);
imshow(uint8(x));
title('Original Image');
subplot(2,2,2);
imshow(uint8(h3));
title('Additive gaussian lena image');

h2 = double(imread('Blurringlena.gif'));
Q2 = UIQI(x, h2);
[MSE2,PSNR2] = msepsnr(x,h2);
display(['BLURRING LENA IMAGE - ','Q = ',num2str(Q2),'  MSE =
 ',num2str(MSE2)]);
subplot(2,2,3);
imshow(uint8(x));
title('Original Image');
subplot(2,2,4);
imshow(uint8(h2));
title('blurring lena image');

h5 = double(imread('JPEGcompressedlena.gif'));
Q5 = UIQI(x, h5);
[MSE5,PSNR5] = msepsnr(x,h5);
figure;
display(['JPEG COMPRESSED LENA IMAGE - ','Q = ',num2str(Q5),'  MSE =
 ',num2str(MSE5)]);
subplot(2,2,1);
imshow(uint8(x));
```

```
title('Original Image');
subplot(2,2,2);
imshow(uint8(h5));
title('JPEG compressed lena image');

% from statistical Image quality
Qa = quality(x, h1);
Qb = quality(x, h4);
Qc = quality(x, h7);
Qd = quality(x, h6);
Qe = quality(x, h3);
Qf = quality(x, h2);
Qg = quality(x, h5);
display(['MEAN SHIFT LENA IMAGE - Q(from IEEE paper) -
 ',num2str(Qa)]);
display(['CONTRAST STRETCHING LENA IMAGE - Q(from IEEE paper) -
 ',num2str(Qb)]);
display(['SALT PEPPER LENA IMAGE - Q(from IEEE paper) -
 ',num2str(Qc)]);
display(['MULTIPLIED SPECKLE LENA IMAGE - Q(from IEEE paper) -
 ',num2str(Qd)]);
display(['ADDITIVE LENA LENA IMAGE - Q(from IEEE paper) -
 ',num2str(Qe)]);
display(['BLURRING LENA IMAGE - Q(from IEEE paper) - ',num2str(Qf)]);
display(['JPEG COMPRESSED LENA IMAGE - Q(from IEEE paper) -
 ',num2str(Qg)]);
```

```
MEAN SHIFT LENA IMAGE - Q = 0.98942  MSE = 224.9993
CONTRAST STRETCHING LENA IMAGE - Q = 0.93719  MSE = 225.0932
SALT PEPPER LENA IMAGE - Q = 0.64938  MSE = 225.3684
MULTIPLIED SPECKLE LENA IMAGE - Q = 0.44076  MSE = 224.7482
ADDITIVE GAUSSIAN LENA IMAGE - Q = 0.38911  MSE = 225.1804
BLURRING LENA IMAGE - Q = 0.34612  MSE = 224.1397
JPEG COMPRESSED LENA IMAGE - Q = 0.28755  MSE = 215.1139
MEAN SHIFT LENA IMAGE - Q(from IEEE paper) - 1144075088.8882
CONTRAST STRETCHING LENA IMAGE - Q(from IEEE paper) - 869411853.7359
SALT PEPPER LENA IMAGE - Q(from IEEE paper) - 859776802.9234
MULTIPLIED SPECKLE LENA IMAGE - Q(from IEEE paper) - 859566134.9523
ADDITIVE LENA LENA IMAGE - Q(from IEEE paper) - 860444053.7026
BLURRING LENA IMAGE - Q(from IEEE paper) - 853484472.8481
JPEG COMPRESSED LENA IMAGE - Q(from IEEE paper) - 865101095.3565
```

Original Image

Mean shift lena image

Original Image

Contrast stretching lena image

Original Image

Salt pepper lena image

Original Image

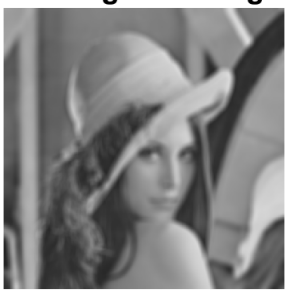
Multiplied speckle lena image

Original Image

Additive gaussian lena image

Original Image

blurring lena image



Original Image

JPEG compressed lena image

MSE & PSNR

```
function [MSE,PSNR] = msepsnr(x,h)
[m,n] = size(x);
MSE = sum(sum(((x-h).^2)))/(m*n);
PSNR = 10*log10((255^2)/MSE);
end
```

Universal Quality Index

```
function quality = UIQI(img1, img2)
block_size = 8;
N = block_size.^2;
sum2_filter = ones(block_size);

img1_sq   = img1.*img1;
img2_sq   = img2.*img2;
img12 = img1.*img2;

img1_sum   = filter2(sum2_filter, img1, 'valid');
img2_sum   = filter2(sum2_filter, img2, 'valid');
img1_sq_sum = filter2(sum2_filter, img1_sq, 'valid');
img2_sq_sum = filter2(sum2_filter, img2_sq, 'valid');
img12_sum = filter2(sum2_filter, img12, 'valid');

img12_sum_mul = img1_sum.*img2_sum;
img12_sq_sum_mul = img1_sum.*img1_sum + img2_sum.*img2_sum;
numerator = 4*(N*img12_sum - img12_sum_mul).*img12_sum_mul;
denominator1 = N*(img1_sq_sum + img2_sq_sum) - img12_sq_sum_mul;
denominator = denominator1.*img12_sq_sum_mul;

quality_map = ones(size(denominator));
index = (denominator1 == 0) & (img12_sq_sum_mul ~= 0);
quality_map(index) = 2*img12_sum_mul(index)./img12_sq_sum_mul(index);
index = (denominator ~= 0);
quality_map(index) = numerator(index)./denominator(index);

quality = mean2(quality_map);
end
```

Universal quality index(our code)

```
function Q=quality(x,y)

       m1=mean(mean(x));
       m2=mean(mean(y));
```

```
        i1 = x-m1;
        i2 = y-m2;
        v1 = sum(sum(i1.*i1))/(numel(x)-1);
        v2 = sum(sum(i2.*i2))/(numel(x)-1);
        covari = sum(sum((i1.*i2)))/(numel(x)-1);
        Q=((4*covari*m1*m2)/((v1+v2))*((m1^2)+(m2^2)));
end
```

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