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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);

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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



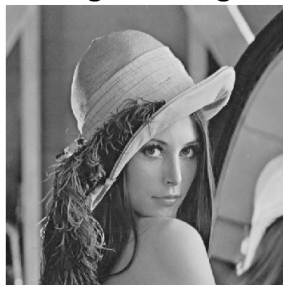
Original Image



Salt pepper lena image



Original Image



Multiplied speckle lena image



Original Image



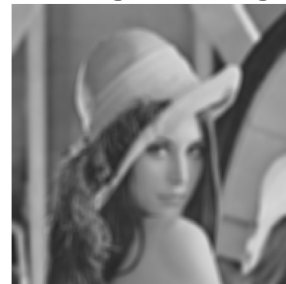
Additive gaussian lena image



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
```

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