Cairo University
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Image Compression using Wavelets

Presented for MTH1172 project

Presented to

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IMAGE COMPRESSION

Appendix

CODE 1

```
%wavelet based compression sub − band coding
clear all;
% CLOSE ALL  closes all the open figure windows.
close all;
X = imread('cameraman.tif');
He  = entropy(X);
X = X(1:256, 1:256);
figure;
%load woman;
%subplot(2, 1, 1);
imshow(uint8(X));
[a1, a2] = size(X);
disp('The number of rows in input image are');
disp(a1);
disp('The number of coloums in input image are');
disp(a2);
figure;
title('Input image');
% Perform single − level decomposition
% of X using haar.
[cA1, cH1, cV1, cD1]  =  dwt2(X, 'haar');
% Images coding.
[C, S]  =  wavedec2(X, 1, 'haar');
A1  =  wrcoef2('a', C, S, 'haar', 1);
H1  =  wrcoef2('h', C, S, 'haar', 1);
V1  =  wrcoef2('v', C, S, 'haar', 1);
D1  =  wrcoef2('d', C, S, 'haar', 1);
%Display the results of a first level decomposition.
colormap(gray);
subplot(2, 2, 1); image(wcodemat(A1, 192));
title('Approximation A1')
subplot(2, 2, 2); image(wcodemat(H1, 192));
title('Horizontal Detail H1')
subplot(2, 2, 3); image(wcodemat(V1, 192));
```

```
title('Vertical Detail V1')
subplot(2,2,4); image(wcodemat(D1,192));
title('Diagonal Detail D1')
%disp(cod_cA1);
%Multi-level 1-D wavelet reconstruction.
re_ima1 = idwt2(cA1,cH1,cV1,cD1,'haar');
re_ima = uint8(re_ima1);
figure;
subplot(2,1,1);
imshow(uint8(X));
title('Input image');
subplot(2,1,2);
imshow(re_ima);
title('1-level reconstructed image');
figure;
%To perform a level 2 decomposition of the image
%X using haar
[C,S] = wavedec2(X,2,'haar');
% decomposse the image X in Level 2
%image coding
A2 = wrcoef2('a',C,S,'haar',2);
A1 = wrcoef2('a',C,S,'haar',1);
H1 = wrcoef2('h',C,S,'haar',1);
V1 = wrcoef2('v',C,S,'haar',1);
D1 = wrcoef2('d',C,S,'haar',1);
H2 = wrcoef2('h',C,S,'haar',2);
V2 = wrcoef2('v',C,S,'haar',2);
D2 = wrcoef2('d',C,S,'haar',2);
colormap(gray);
subplot(2,4,1); image(wcodemat(A1,192));
title('Approximation A1')
subplot(2,4,2); image(wcodemat(H1,192));
title('Horizontal Detail H1')
subplot(2,4,3); image(wcodemat(V1,192));
title('Vertical Detail V1')
subplot(2,4,4); image(wcodemat(D1,192));
title('Diagonal Detail D1')
subplot(2,4,5); image(wcodemat(A2,192));
title('Approximation A2')
```

```
subplot(2,4,6); image(wcodemat(H2,192));
title('Horizontal Detail H2')
subplot(2,4,7); image(wcodemat(V2,192));
title('Vertical Detail V2')
subplot(2,4,8); image(wcodemat(D2,192));
title('Diagonal Detail D2')
dec2d = [A2,A1,H1,V1,D1,H2,V2,D2];
%Multi - level 2 - D wavelet reconstruction.
re_ima1 = waverec2(C,S,'haar');
re_ima = uint8(re_ima1);
figure;
subplot(2,1,1);
imshow(uint8(X));
title('Input image');
subplot(2,1,2);
imshow(re_ima);
title('2 - level reconstructed image');
%figure;
%y = imsubtract(uint8(X), re_ima);
%imshow(y); title('error image');
% Using some plotting commands,
% the following figure is generated.
n = input('enter the decomposition level');
X = imread('cameraman.tif');
X = X(1:256,1:256);
X = double(X) - 128;
%To compute four filters associated
[Lo_D,Hi_D,Lo_R,Hi_R] = wfilters('haar');
%Multilevel 2 - D wavelet decomposition.
[c,s] = wavedec2(uint8(X),n,Lo_D,Hi_D);
disp('Decomposition vector of size 1 * 524288 is stored in c');
disp('Coressponding book keeeping matrix');
disp(s);
[thr,nkeep] = wdcbm2(uint8(dec2d),62.3417,prod(s(1,:)));
%Default values for de - noising or compression.
[THR,SORH,KEEPAPP,CRIT] = ddencmp('cmp','wp',uint8(X));
%De - noising or compression using wavelet packets.
[XC,TREED,PERF0,PERFL2] =
wpdencmp(X,SORH,2,'haar',CRIT,THR,KEEPAPP);
```

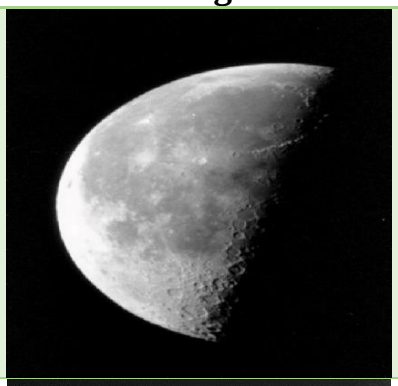
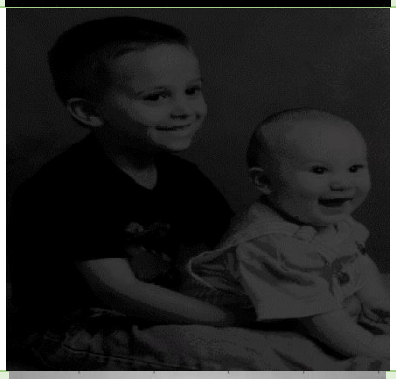
```
disp('Level − dependent thresholds');
disp(THR);
disp('The entropy used is');
disp(CRIT);
disp('The type of thersholding is');
if SORH == s
  disp('Soft Thresholding');
else
  disp('Hard Thresholding');
end
disp('Approximation coefficients are');
disp(KEEPAPP);
disp('Wavelet packet best tree decomposition of XD');
disp(TREED);
disp('The L^2 recovery');
disp(PERFL2);
disp('The compression scores in percentages');
disp(PERF0);
XC = double(X) + 128;
figure;
%subplot(2, 1, 1);
%imshow(uint8(X));
%title('Original Image');
%subplot(2, 1, 2);
imshow(uint8(XC));
title('Output image');
[b1, b2] = size(XC);
disp('The number of rows in compressed image are');
disp(b1);
disp('The number of coloums in image are');
disp(b2);
disp('entropy is');
disp(He);
%figure;
%y = imsubtract(uint8(X), uint8(XC));
%imshow(y); title('error image');
%INFO = IMFINFO(X, bmp);
%INFO1 = IMFINFO(XC, bmp);
```

CODE 2

Measures of effectiveness focused code

```
%MY OPTIMIZED CODES
K = imread('cameraman.tif'); % i'hv used grayscale 256by256 image
He = entropy(K);
m = std2(K);
[C, S] = wavedec2(K, 1, 'bior3.7');
thr = m;
[Xcomp, CXC, LXC, PERF0, PERFL2] =
wdencmp('gbl', C, S, 'bior3.7', 1, thr, 'h', 1);
NbColors = 255;
map = gray(NbColors);
colormap(map);
subplot(1, 2, 1); image(K); title('Original Image');
axis square
subplot(1, 2, 2); image(Xcomp); title('Compressed Image');
axis square
disp('The compression ratio is')
disp(PERF0)
disp('Retained Energy is')
disp(PERFL2)
Z = double(K);
W = double(Xcomp);
M = 256;
N = 256;
for y = 1:256
 for x = 1:256
   MSE = (1/(M * N)) * ((Z(x, y)) - (W(x, y)))^2;
 end
end
    disp('MSE value of decompressed image is');
disp(MSE)
disp('PSNR value of decompressed image is');
 PSNR = 10 * log10((255^2)/MSE);
 disp(PSNR);
 disp('The entropy of image is');
 disp(He);
 disp('The standard divation of image is');
 disp(m);
```

Data Used

Figure #	Image	Notes
(4.1)		Original Image Image Entropy = 5.5128 Its Standard deviation = 78.0031
(4.6)		Original Image Image Entropy = 5.5169 Its Standard deviation = 19.2288
(4.11)		Original Image Image Entropy = 7.0097 Its Standard deviation = 62.3417