7. Transform image compression (test image lenna.tif can be found at ftp://ftp.cs.sjtu.edu.cn:990/lu-ht/DIP/images**)**

(a) Investigate image compression based on DCT. Divide the image into 8-by-8 subimages, compute the two-dimensional discrete cosine transform of each subimage, compress the test image to different qualities by discarding some DCT coefficients based on zonal mask and threshold mask and using the inverse discrete cosine transform with fewer transform coefficients. Display the original image, the reconstructed images and the difference images.

(b) Investigate image compression based on wavelets. Consider four types of wavelets:

Haar: $h0 = \left[\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}\right]$, $h1 = \left[\frac{1}{\sqrt{2}}, -\frac{1}{\sqrt{2}}\right]$

Daubechies: 8-tap

n	$g_0(n)$	$h_0(n)$	$g_1(n)$	$h_1(n)$
0	0.23037781	$g_0(7-n)$	$(-1)^n h_0(n)$	$g_1(7-n)$
1	0.71484657			
2	0.63088076			
3	-0.02798376			
4	-0.18703481			
5	0.03084138			
6	0.03288301			
7	-0.01059740			

Symlet: 8-tap

n	$g_0(n) = h_\varphi(n)$	$h_0(n)$	$g_1(n)$	$h_1(n)$
0	0.0322	$g_0(7-n)$	$(-1)^n h_0(n)$	$g_1(7-n)$
1	-0.0126			
2	-0.0992			
3	0.2979			
4	0.8037			
5	0.4976			
6	-0.0296			

7	-0.0758			

n	$h_0(n)$	$h_1(n)$	n	$h_0(n)$	$h_1(n)$
0	0	0	9	0.8259	0.4178
1	0.0019	0	10	0.4208	0.0404
2	-0.0019	0	11	-0.0941	-0.0787
3	-0.017	0.0144	12	-0.0773	-0.0145
4	0.0119	-0.0145	13	0.0497	0.0144
5	0.0497	-0.0787	14	0.0119	0
6	-0.0773	0.0404	15	-0.017	0
7	-0.0941	0.4178	16	-0.0019	0
8	0.4208	-0.7589	17	0.0010	0

The biorthogonal Cohen-Daubechies-Feauveau:

$$g_0(n) = (-1)^{n+1} h_1(n), \qquad g_1(n) = (-1)^n h_0(n)$$

Decompose the test image by wavelets to 3 levels, truncate the wavelet coefficients to 0 below some threshold. And reconstruct image from the left coefficients. Display the wavelet transforms of the image, the reconstructed images and the difference images.

(Consult Chapter 7 for more technique details).