

San Diego State University
CompE 565: Multimedia Communication Systems
Spring 2022
HW 2 (due on 3/12//2022 at 11:59 pm)

Project on JPEG based Image Compression:

For the image given in Home Assignment 1, implement the following:

Encoder: (Use 4:2:0 YCbCr component image)

- (a) Compute the 8x8 block DCT transform coefficients of the luminance and chrominance components of the image.
- Please display the DCT coefficient matrix as well as image of the DCT transformed image blocks of the first 2 blocks in the 6th row (of blocks) from top for the luminance component. (15 points)
- (b) Quantize the DCT image by using the JPEG luminance and chrominance quantizer matrix from the lecture notes.
- Report the following output only for the first 2 blocks in the 6th row from top of the luminance component: (a) DC DCT coefficient; (b) Zigzag scanned AC DCT coefficients. (20 points)

Decoder:

- (c) Compute the inverse Quantized images obtained in Step (b). (10 points)
- (d) Reconstruct the image by computing Inverse DCT coefficients. (15 points)

Your Report should contain information on:

- Reconstructed RGB Image. (Note: This image should not look very different from the original) (10 points)
- Display the Error Image (by subtracting the reconstructed image from the original) for the luminance image. (10 points)
- PSNR for the luminance component of the decoded image. (10 points)
- Comment on the outcomes (10 points)
- Source code

Support Information:

The discrete cosine transform (DCT) helps separate the image into spectral sub-bands of differing importance. DCT transforms a signal or image from the spatial domain to the frequency domain.

Given an input image A, the coefficients for the output "image," B, are:

$$B(k,l) = \sum_i^M \sum_j^N 4A(i,j) \cos\left[\frac{(2i+1)\pi k}{2M}\right] \cos\left[\frac{(2j+1)\pi l}{2N}\right]$$

The input image block is M pixels by N pixels; A(i,j) is the intensity of the pixel in row i and column j; B(k,l) is the DCT coefficient in row k and column l of the DCT matrix. All DCT multiplications are real.

Note: There is a command 'dct2' to perform DCT in Matlab. Please refer to the 'MATLAB basics and tips and tricks.m' uploaded on the blackboard.

In a compression application: The image is divided into 8x8 blocks and each block is input to the DCT. The output array of DCT coefficients contains integers which can range from -1024 to 1023. For most images, much of the signal energy lies at low frequencies; these appear in the upper left corner of the DCT. The lower right values represent higher frequencies, and are often small - small enough to be neglected with little visible distortion.