San Diego State University

CompE 565: Multimedia Communication Systems

Spring 2020

HW 2 (due on 3/22//2019 at 11 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 form 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.