# Assignment 3

Digital Signal Analysis and Applications (DSAA) - IEC 239

Deadline: 2nd April 11:50pm

March 25, 2017

1. Implement the following functions:

   (a) create_mat_dct(), which outputs the the 8-point 2D-DCT basis function F. The function for computing the basis is given as: $F(v,u) = r\cos\{\frac{2\pi(2u+1)v}{2N}\}$, where $r = \sqrt{1/N}$ if $v = 0$ and $r = \sqrt{2/N}$, otherwise (verify your result using dctmtx() function in Matlab).

   (b) myDCT(im,F), which takes as input any given $8 \times 8$ image im and the basis matrix F. The output of this function is the DCT transformed image.

   (c) myIDCT(im,F), which computes the inverse DCT transform

   (d) myDCT_quantization(imDCT,qm,c), which takes as input the DCT transformed block imDCT, the quantization matrix qm and the compression factor c (divide image by c times the quantization matrix). Output is the quantized DCT image (imqDCT).

   (e) myDCT_dequantization(imqDCT,qm,c), which de-quantizes the quantized DCT image

   (f) RMSE(im1,im2), which computes RMSE error between two images of arbitrary size

   (g) My_entropy(im), which computes the entropy of a given image (you can use the imhist() function in Matlab to do it efficiently)

2. Observe the DCT, quantized DCT and reconstructed image for the $8\times8$ subwindows extracted from the LAKE image and whose top left corners are at the coordinates: (45,420), (298,427) and (230,30). For that you will use the classical quantization matrix for luminance and c=2. Comment on the observations.

3. Apply the DCT transform (and quantization) to all $8 \times 8$ sub windows of the

LAKE image and create an image with all the resulted DCT images at the same positions as their corresponding image (take DCT of each patch independently, the resulting output will be of the same size as input patch, place the patch on the original position in the image). Comment on your observations.

4. Reconstruct the image. Find the highest value of c so that the distortions of the reconstructed image are just perceptible. Give the corresponding entropy and RMSE for each case (for different values of c). Explain the results obtained with c=10.

5. By varying the value of c, observe the evolutions of the entropy and of the RMSE. Plot entropy versus RMSE.

6. Design an experiment to test the hypothesis that using DCT gives better compression than using DFT (when using subdivision of $8 \times 8$ images). Use a set of 10-15 images for your experiment. Note that with such a small set of images, the findings may or may not be conclusive, however your experimental design must be correct.

7. Experimentally prove the perceptual redundancies in the YCbCR channel. You can choose a color image of your choice to do the experiments.