EE6310 Image and Video Processing, Spring 2023

Indian Institute of Technology Hyderabad
Homework 5, Assigned 08.04.2023, Due **11:59 pm on 17.04.2023.**

The development of general ability for independent thinking and judgment should always be placed foremost, not the acquisition of special knowledge. – Albert Einstein

Remarks:

- Do **not** use built-in functions.
- Please use the *lighthouse.png* image.

1 Optimal Decorrelating Transform

1. Implement principal component analysis (PCA) to decorrelate an image. Divide the image into non-overlapping 8×8 patches and vectorize the patches into 64-dimensional vectors. Find the covariance matrix using all the image patches. Ensure that the data is zero-mean (feature-wise). Reconstruct the image at three different "compression" levels of 48, 32 and 16 dimensions and display it. Again, be sure to add the mean back. Is the PCA effective in decorrelating images? (10)

2 Discrete Cosine Transform

Write a program to implement a JPEG-like image encoder using the following steps. (10)
Encoder:

1. Divide the image into non-overlapping blocks of 8×8 pixels.
2. Apply the Type-II DCT to each of the blocks (defined in the slides).
3. Divide each block by the quantization matrix. Look up the quantization matrix Q in the slides. Verify that you are left with sparse coefficients at this point.

Decoder:

1. Multiply each block with the inverse Q matrix.
2. Apply the Type-II IDCT to each block.
3. Put the sub-blocks together to generate the decoded estimate of the original image.

Display the original and "lossy-compressed" images. Is the DCT effective for image compression?