**CM0669 Machine Learning and Computer Vision**

**Lab 7** Digital Image Transforms, DCT, DFT, DWT.

**1. Colour transforms**

Open up Matlab and Type in ‘help rgb2ntsc’ and ‘help rgb2ycbcr’. A helpful description will be given on the built-in functions ‘rgb2ntsc’ and ‘rgb2ycbcr’ for transforming a colour RGB image into another colour space. Download the colour images in a folder (Week7).

1. Create a Matlab code which reads a colour image (‘image1.jpg’) , transforms the colour space into YCbCr, displays the luminance and chrominance images and saves the luminance plane in a jpg file. Execute the code for the other colour images.
2. Amend the previous code to display the NTSC planes for each colour image.
3. The Matlab function getEnergy.m is a function which calculates the energy of a signal.

The energy *E* of an image of size *M*×*N* is given by

*f*(*i*,*j*) is the value of the image at coordinate (i,j)

1. Execute the Matlab function and record the energy of images in the following table

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Energy | | | | | |
|  | Red | Green | Blue | Y | Cb | Cr |
| Image1.jpg |  |  |  |  |  |  |
| Image2.jpg |  |  |  |  |  |  |
| Image3.jpg |  |  |  |  |  |  |

Discuss the results.

**2. Fourier, cosine, and wavelet transforms – De-correlation, Energy Compaction.**

1. Create a Matlab code which does the following
2. Read a greyscale picture
3. Display the pixel values in a 5×5 square region.
4. Calculate the Discrete Fourier Transform of the full image
5. Calculate the energy of the spectrum.
6. Display a set of coefficients in a 5×5 squared region of the spectrum.
7. Calculate the energy of a squared region at the centre of the spectrum of size (100 × 100).
8. Run the code on all greyscale pictures and discuss the results.

**Hints**: use ‘fft2’ to transform the image and ‘abs’ to get the spectrum.

1. Create a Matlab code which does the following
2. Read a greyscale picture
3. Display the pixel values in a 5×5 square region
4. Calculate the Dsicrete Cosine Transform of the full image
5. Calculate the energy of the DCT image.
6. Display a set of coefficients in a 5×5 squared region of the transformed image.
7. Calculate the energy of a squared region at the top left corner of the DCT (of size 100×100).

g. Reconstruct and display the picture by using only coefficients in the squared region (100 × 100).

1. Run the code on all greyscale pictures and discuss the results.

**Hints**: use ‘dct2’ to transform the image and ‘idct2’ to get the inverse transform.

1. Create a Matlab code which does the following

a. Read a greyscale picture.

b. Display the pixel values in a 5×5 square region.

c. Calculate the Discrete Wavelet Transform of the full image at two levels using the wavelet ‘Daubechies 2’.

d. Calculate the energy of the transformed image (all sub-bands).

e. Display a set of coefficients in a 5×5 squared region of the transformed image.

f. Calculate the energy of the approximation sub-band A1.

g. Reconstruct and display the picture by using only coefficients in the approximation sub-band A1.

h. Run the code on all greyscale pictures and discuss the results.

**Hints**: use ‘dwt2’ to transform the image and ‘idwt2’ to get the inverse transform.

**Note:** Once they are read, the images should be converted into ‘double’ for processing. Also, ensure that the reconstructed images are converted into ‘uint8’ before they are displayed.