IMAGE COMPRESSION USING DCT(in MATLAB):

The discrete cosine transform (DCT) is a technique for converting a signal into elementary frequency components. Like other transforms, the Discrete Cosine Transform (DCT) attempts to de correlate the image data. After de correlate each transform coefficient can be encoded independently without losing compression efficiency.

- DCT stands for Discrete Cosine Transform.
- It represents an image as a sum of sinusoids of varying magnitudes and frequencies.
- DCT is an outcome of the efforts to make DFT (Discrete Cosine Transform) having real values instead of complex values.
- DCT coefficients are real valued while DFT coefficients are complex, therefore, hardware implementation of DCT is easier than DFT.

DCT is equivalent to computing 2N point DFT of signal which is made even symmetric by its extension.

Where N point DFT of a sequence x[n] is given by

$X[k] = \Sigma\, x[n] * \exp(j2\pi k * n/N)$; over n=0 to N-1.

The following is a general overview of the

JPEG process:

- The image is broken into 8×8 blocks of pixels.
- Working from left to right, top to bottom, the DCT is applied to each block.
- Each block is compressed through quantization.
- The array of compressed blocks that constitute the image is stored in a drastically reduced amount of space.
- When desired, the image is reconstructed through decompression, a process that uses the inverse Discrete Cosine Transform (IDCT).

DCT has the property that, for a typical image, most of the visually significant information about the image is concentrated in just a few coefficients of the DCT. This property is known as ***ENERGY COMPACTION*** property. Hence, DCT finds its importance in image compression technique.

2D-FDCT (2 Dimensional Forward DCT):

The two-dimensional DCT of an M*N image f (x, y) is as follows

F (p ,q) =αp*αq

ΣΣ f(x, y) cos[π(2x+1)p/2M] cos[π(2y+1) q/2N]

Where 0 ≤ p ≤ M

1 and 0 ≤ q ≤ N 1 and

αp = 1/sqrt(M) ; p=0

=sqrt(2/M); 1 ≤ p ≤ M 1;

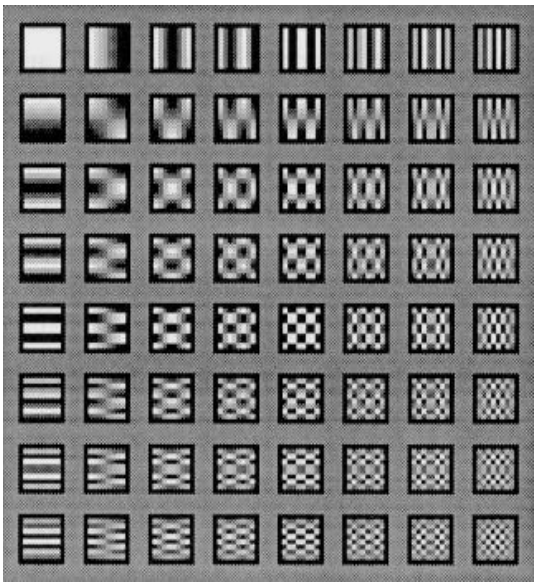
αq = 1/sqrt(N); q=0

=sqrt(2/N); 1≤ q ≤ N 1;

From the 2D FDCT and the 2D inverse DCT(IDCT) we find the term:

αp*αq cos [π(2 x+ 1 / M)] cos[π(2 y+ 1) / N]

Common and same in both the expressions. These functions are called as ***BASIS FUNCITONS OF DCT***.



(DCT basis functions)

The Basis functions for 8 * 8 matrix are shown

- Horizontal frequencies increase from the left to right, and vertical frequencies increase from the top to bottom.
- The constant valued basis function at the upper left is called as DC basis function and corresponding coefficient is called DC coefficient. Rest of the coefficients are called AC coefficients.

DCT Computation using FFT approach:

- It utilizes the FFT structure for speedy computation of DCT, hence suitable for large input images.
- In MATLAB it is achieved by using dct2() function
- Since DCT has very good energy compaction capability, it means that the information is being carried by fewer DCT coefficients , and therefore, large number of coefficients can be neglected to achieve image compression.

DCT Drawbacks:

- A common issue with DCT compression in digital media is ***BLOCKY COMPRESSION ARTIFACTS,*** caused by DCT blocks. The DCT algorithm can cause block-based artifacts when heavy compression technique is applied.
- Truncation of higher spectral coefficients results in blurring of the images, especially wherever the details are high.
- Coarse quantization of some of the low spectral coefficients introduces graininess in the smooth portions of the image.