Practical No : 01.

AIM : a) 2D Linear Convolution.
b) Circular convolution between two 2D matrices

Theory : The term linear indicates that a pixel is replaced by the linear combination of its neighbors. Convolution is basically a mathematical operation where each value in the input multiplied by a set of weighting coefficients. Depending upon the weighting coefficients, convolution operation is used to perform spatial domain low-pass & high pass filtering of the image.

2D convolution can be represented as a sequence of two 1D convolutions only if the signals are separable.

Convolution can be performed either in the spatial domain or in the frequency domain.

Practical NO: 2.

AIM: Circular convolution expressed as linear convolution plus alias.

Theory: let us consider two signals $x[m,n]$ & $h[m,n]$. The two signals are given by $x[m,n]$ & $h[m,n]$. The result of linear convolution between $x[m,n]$ & $h[m,n]$ is given by $y[m,n] = x[m,n] * h[m,n]$. The result of which has three rows & three columns.

It is known that in case of circular convolutn the length of result is 2×2.

1- The Three column are denoted by C_1, C_2, C_3. Here it is noted that the third column in an alias of the first column. Hence the third column is added with the first column & the result is shown.

2- The Three rows are denoted by R_1, R_2 & R_3. Here it is noted that the third row is an alias of the first row. Hence the resul of circular convolution between $x[m,n]$ & $h[m,n$

conclusion: It can be concluded that circular convolution is nothing but linear convolution plus alias.

Practical NO : 03.

AIM : a) Linear Cross corelation of a 2D Matrix.
b) Circular correlation between two Signals.
c) Linear auto correlation of a 2D Matrix.
d) Linear cross correlation of a 2D Matrix.

Theory : Correlation is a signal matching techniq
It is an important component of radar, Sonar, digital communications & many other Systems.

2- Correlation is mathematically Similar to convolut
3- Correlation can be classified into two types as linear correlation & circular convolution
4- Auto correlation is basically a Signal correlat with itself.
5- The amplitude of each sample in the Cross-correlation is a measure of how muc one signal resembles with other.
6- The method to perform linear & circula correlation is given in detail.

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conclusion: It is concluded that correlation can be broadly classified as i) autocorrelation & ii) Cross-correlation. If one finds the similarit of a signal to itself then it is auto-correlation.

Practical No: 4.

AIM: DFT of a 4x4 gray Scale image.

Theory:
The 2D-DFT of a rectangular image $f(m,n)$ of size $M \times N$ is represented as.

$$f(m,n) \xrightarrow{\text{2D-DFT.}} F(k,l)$$

The 2D-DFT of the image $f[m,n]$ is represented as $F[k,l]$.

$$F[k,l] = \text{kernel} \times f[m,n] \times (\text{kernel})^T$$

The kernel or basis of the Fourier Transform for $N=4$
The DFT basis for $N=4$ is given by $\begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -j & -1 & j \\ 1 & -1 & 1 & -1 \\ 1 & j & -1 & -j \end{bmatrix}$

upon Simplification we get

$$F(k,l) = \begin{bmatrix} 4 & 4 & 4 & 4 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix} \times \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -j & -1 & j \\ 1 & -1 & 1 & -1 \\ 1 & j & -1 & -j \end{bmatrix} = \begin{bmatrix} 16 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

Conclusion: It is concluded that the Fourier transform of the input results in only one value & all other values are zero.

Practical No: 05.

AIM : a) compute discrete cosine transform.
b) perform KL transform for the given 2D Matrix

Theory : The discrete cosine transforms are the members of a family of real-valued discrete sinusoidal unitary transform.
A discrete cosine transform contains a set of basis vectors that are sampled cosine functions.

DCT is a technique for converting a signal into elementary frequency components & it is widely used in image compression.

If $x[n]$ is the signal of length N, The fourier transform of the signal $x[n]$ is given by where

$$X[k] = \sum_{n=0}^{N-1} x[n] e^{-j\frac{2\pi kn}{N}}$$

where k varies between 0 to $N-1$

The formula to compute the DCT matrix is given by

$$X[k] = \alpha(k) \sum_{n=0}^{N-1} x[n] \cos\left\{\frac{(2n+1)\pi k}{2N}\right\}, \text{ where } 0 \leq k \leq N-1$$

Conclusion: The discrete cosine transform has excellent energy compaction for highly correlated data.

Practical No: 06.

AIM : a) Brightnen enhancement of an image.
b) Contrast Manipulation.
c) image negetive.

Theory:

a) Brightnen Modification : The brightness of an image depends on the value associated with the pixel of image. When changing the brightnen of an image, a constrast can be added or substracted from the luminance of all sample values. The brightnen of an image can be increased by adding a constant value to each & every pixel of image.

b) Contrast Manipulation : Contrast adjustment is done by Scaling all the pixels of image by a constant k. It is given by

$$g[m,n] = f[m,n] * k.$$

Changing the contrast of an image, changes the range of luminance values present in the image.

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c) Image Negative:

The inverse transformation reverses light & dark. An example of inverse transformation is an image negative. A negative image is obtained by Substracting each pixel from the maximum pixel value.

Negative images are useful in the display of medical images & producing negative prints of images.

Practical No: 7.

AIM: a) perform threshold operations.
b) perform grey level Slicing without background.

Theory:
Threshold is required to extract a part of an image which contains all the information. Thresholding is a part of a more general Segmentation problem.
Threshold can be broadly clarified as hard thresholding & Soft thresholding.

In hard thresholding pixels having intensity lower than the threshold T are set to zero & the pixels having intensity greater than the threshold are set to 255 or left at their original intensity depending on the effect that is required.

b) The purpose of gray level slicing is to highlight a specific range of gray values. Two different approaches can be adopted for grey level Slicing.
This displays high values for a range of interest & low values in other areas.

Conclusion : From the result, it is obvious that as the value of the threshold is increased, the image becomes too dark. The optimal threshold is found to be 160.

Practical No: 08.

AIM: Image ~~Segmentation~~. Compression.

Theory:
The Block Truncation coding (BTC) technique is based on preserving the first & Second Statistical moments of the image. The BTC method was first proposed by Delp & Mitchell in 1979.
Block Truncation coding divides the image into blocks.
The block size is usually 3x3 or 4x4 pixels. Within each block, a threshold is chosen, & the value at each pixel is coded as 0 or 1 depending on whether it is above or below the threshold.
BTC attempts to preserve the mean & variance of each block.
BTC lends itself very nicely to parallel processing since the coding of each of the blocks is totally independent.

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conclusion: From the observed result, it is clear that as the block size increases, the quality of the reconstructed image decreases & the blocking artifact becomes visible.

Practical No: 10.

AIM: a) Binary Image processing
b) color Image processing.

Theory:

a) The basic operations are dilation & erosion. They are expressed by a kernel operating on an input binary image, x. where white pixels denote uniform regions & black pixels denote region boundaries. Erosion & dilation work conceptually by translating a structuring element, B, over the image points & examining the intersection between the translated kernel coordinates & image coordinates.

b) colour models provide a Standard way to specify a particular colour by defining a 3D coordinate system. & subspace that contains all constructible colours within a particular model. Each colour model is oriented towards a specific software or image processing application.
In an RGB colour model, the three primary colours red, green & blue form the axis of the cube which is each point in the cube represents a specific

colour.

RGB is an additive colour model.

Magenta = Red + Blue
Yellow = Red + Green
Cyan = Blue + Green.