UNIT I DIGITAL IMAGE FUNDAMENTALS

ELEMENTS OF DIGITAL IMAGE PROCESSING (DIP)

1 What is a pixel?

Definition 1:

Pixel is the smallest individual element of a digital image. Every pixel has a particular location and brightness.

Definition 2:

A digital image is composed of a finite number of elements each of which has a particular location or value. These elements are referred to as pixels or image elements or picture elements or pixels.

2 Define – Digital Image

Digital image is defined as two dimensional light intensity function f(x, y) where x and y denote spatial co-ordinate. The amplitude or value of f at any point (x, y) is called intensity or gray value or brightness of the image at that point.

3 What are the steps involved in Digital Image Processing (DIP)?

The steps involved in DIP are:

i. Image Acquisition
ii. Preprocessing
iii. Segmentation
iv. Representation and Description
v. Recognition and Interpretation

4 List out the categories of digital storage.

The categories of digital storage are

i. Short term storage for use during processing
ii. Online storage for relatively fast recall
iii. Archival storage for infrequent access

5 **What is dynamic range?**

The range of values spanned by the gray scale is called dynamic range of an image. Image will have high contrast, if the dynamic range is high and image will have

dull washed out gray look, if the dynamic range is low.

6 **Define – Digital Image Processing**

Digital image processing is defined as the process of analyzing and manipulating digital images using digital computer.

7 What are the types of connectivity?

There are three types of connectivity.They are:

i. 4-connectivity

ii. 8-connectivity and

iii. M connectivity (mixed connectivity)

8 Write the formula for calculating D_4 and D_8 distance .

D4 distance (city block distance) is defined by,

$$D4(p, q) = |x-s| + |y-t|$$

D8 distance(chess board distance) is defined by,

$$D8(p, q) = \max(|x-s|, |y-t|)$$

where (x,y) and (s,t) are the coordinates of p and q pixel respectively.

9 What is geometric transformation?

Transformation is used to alter the co-ordinate description of image.

The basic geometric transformations are:

i. Image translation

ii. Scaling

iii. Image rotation

ELEMENTS OF VISUAL PERCEPTION, BRIGHTNESS, CONTRAST, HUE, SATURATION, MACHBAND EFFECT

10 Define – Brightness **[M/J - 12]**

Brightness of an object is the perceived luminance of the surround. Two objects with different surroundings would have identical luminance but different brightness.

11 Define – Luminance

Luminance gives a measure of the amount of energy an observer perceives from a light source. It is measured in lumens (lm).

In black and white pictures, better lighted parts have more luminance than the dark areas.

12 **What are the types of light receptors?**

The two types of light receptors are, Cones and Rods.

Cones

i. 6 to 7 million numbers of cones in each eye
ii. Located central portion of the eye called fovea and highly sensitive to color.
iii. Each cone connected to its nerve end
iv. Cone vision is called photopic or bright-light vision

Rods

i. 75to 150 million distributed over retinal surface
ii. Rods connected to a single nerve, hence not involved in color vision
iii. Sensitive to low levels of illumination
iv. Rod vision is called scotopic or dim-light vision

13 How cones and rods are distributed in retina?

In each eye, cones are in the range 6-7 million and rods are in the range 75-150 million.

The distribution of cones and rods in retina is as shown in figure.

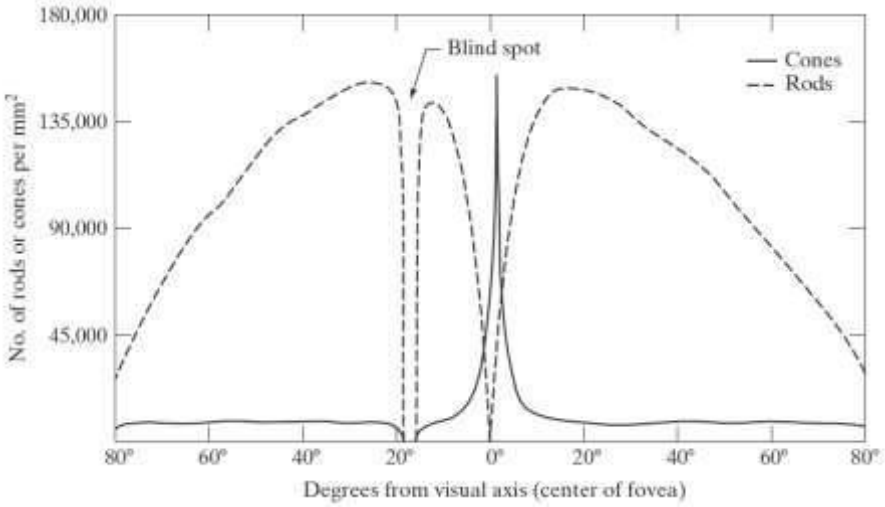


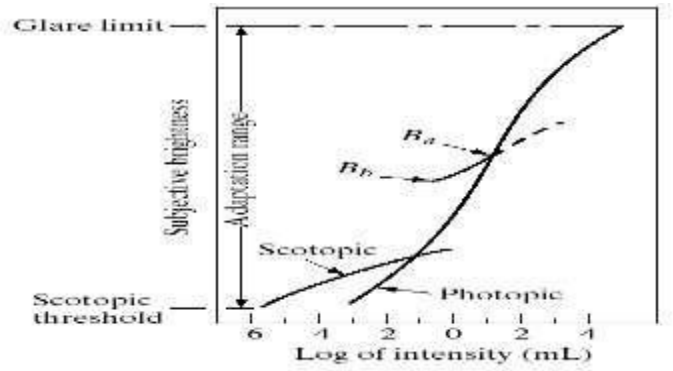
Figure: Distribution of rods and cones in retina

14 Define – Subjective Brightness and Brightness Adaptation

Subjective brightness is defined as the intensity as perceived by the human visual system.

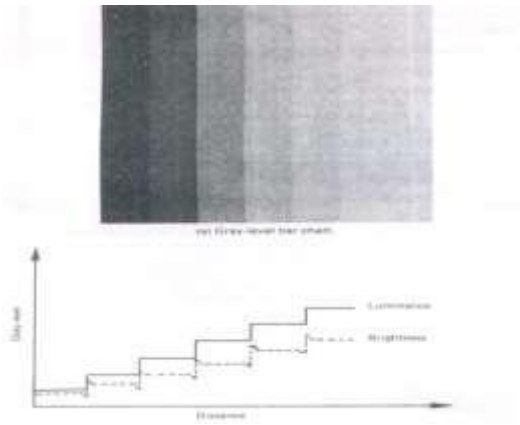
Brightness adaptation :The human visual system can operate only from scotopic to glare limit. It cannot operate over the range simultaneously. It accomplishes this large variation

by changes in its overall intensity. Interpreting the impressive dynamic range is called Brightness Adaptation



15 What is meant by machband effect?

The spatial interaction of luminance from an object and its surround creates a phenomenon called the Mach band effect. This effect shows that brightness is not a monotonic function of luminance. In the bar chart shown, each bar has constant luminance. But the apparent brightness is not uniform along the width of bar. Transitions at each bar appear brighter on the right side and darker on the left side. The dashed line represents the perceived brightness. The overshoots and undershoots illustrate the Mach band effect.



16 What are hue and saturation?

Hue is a color attribute that describes a pure color .This is predominant spectral colour of the received light. The color of any object is distinguished by its hue or tint.The green leaves have green hue and red tomatoes have red hue.Different hues result from different wavelengths of spectral radiation and are perceived as such by the sets of cones in retina.

Saturation is the spectral purity of the color light. Since single hue colors occur rarely alone, this indicates the amount of other color present. Thus saturation may be taken as an

Department of Electronics and Communication Engineering

indication of how little the color is diluted by white.A fully saturated color has no white.(Eg. Vivid green)

Hue+saturation =chrominance (chroma).Chrominance does not contain brightness information

17 **Define – 4 and 8 Neighbors of a Pixel** [N/D - 09]

The pixel p at co-ordinates (x, y) has 4 neighbors (ie) 2 horizontal and 2 vertical neighbors whose co-ordinates is given by (x+1, y), (x-1,y), (x,y-1), (x, y+1). This is called as direct neighbors. It is denoted by N4(P) ,

$$\begin{matrix} & (x-1, y) & \\ (x, y-1) & (x, y) & (x, y+1) \\ & (x+1, y) & \end{matrix}$$

Four diagonal neighbors of p have co-ordinates (x+1, y+1), (x+1,y-1), (x-1, y-1), (x-1, y+1). It is denoted by ND(4). Eight neighbors of p denoted by N8(P) is a combination of 4 direct neighbors and 4 diagonal neighbors.

$$\begin{matrix} (x-1, y-1) & (x-1, y) & (x-1, y+1) \\ (x, y-1) & (x, y) & (x, y+1) \\ (x+1, y-1) & (x+1, y) & (x+1, y+1) \end{matrix}$$

COLOR IMAGE FUNDAMENTALS- RGB, HSI MODELS

18 What is meant by color model?

A color mode also called color space or color system is to facilitate the specification of colors in some standard, generally accepted way. In essence, a color model is a specification of 3D-coordinates system and a subspace within that system where each color is represented by a single point.

19 ist out the hardware oriented color models.

The hardware oriented color models are

i. RGB model

ii. CMY model

iii. YIQ model

iv. HSI model

Department of Electronics and Communication Engineering

IMAGE SAMPLING, QUANTIZATION, DITHER

20 Define – Sampling and Quantization [N/D - 08]

Sampling is digitizing the co-ordinate value (x, y) of the analog continuous image.

Quantization is digitizing the amplitude value.

21 Write the expression for finding the number of bits required to store a digital image.

The expression for number of bits required to store a digital image is,

$b=M * N * k$

When M=N, this equation becomes

$b=N^2k$

M =N = Number of rows and columns respectively

k= number of bits required to represent a single pixel

22 Define –Tapered Quantization

If gray levels in a certain range occur frequently while others occur rarely, the quantization levels are finely spaced in this range and coarsely spaced outside of it. This method is called Tapered Quantization.

2-D Mathematical Preliminaries, 2-D Transform -DFT,DCT,KLT,SVD

23 List out the properties of 2D Fourier transform.

The properties of 2D Fourier transform are:

i. Separability
ii. Translation
iii. Periodicity and conjugate symmetry
iv. Rotation
v. Distributivity and scaling
vi. Average value
vii. Laplacian
viii. Convolution and correlation
ix. Sampling

24 List out the properties of forward transformation kernel.

The kernel is also called as basis function. The properties of kernel are

i. Separable

ii. Symmetry

The forward transformation kernel is said to be separable if g(x, y, u, v)

$g(x, y, u, v) = g1(x, u).g2(y, v)$

The forward transformation kernel is symmetric if g1 is functionally equal to g2

$g(x, y, u, v) = g1(x, u). g1(y,v)$

25 Justify that Karhunen–Loève Transform is an optimum transform.

The Karhunen–Loève Ttransform is an optimum transform because it provides decorrelation and has Minimum Mean Square Error (MMSE) for the same set of partial coefficient.

26 What is called separable image transform?

If the 2D transform can be computed by first computing 1-D transform along each row of the input image, and then computing a 1-D transform along each column of this intermediate result,then that kind of transform is called separable image transform.

27 List out the properties of Singular Value Decomposition (SVD).

The properties of Singular Value Decomposition are:

i. Unitary SVD transform

ii. Best Approximation of (input image),U

28 What is the need for transform?

i. Fast computation

e.g., convolution vs. multiplication for filter with wide support

ii. Conceptual insights for various image processing

e.g., spatial frequency information (smooth, moderate change, fast change, etc.)

iii. Obtain transformed data as measurement

e.g., blurred images, radiology images (medical and astrophysics)

iv. For efficient storage and transmission

Department of Electronics and Communication Engineering

29 What are the applications of transform?

The applications of transform are:

i. Image enhancement (DFT)

ii. Image segmentation (DWT)

iii. Image compression (DCT,DWT)

30 List out the properties of two-dimensional DFT .

The properties of two-dimensional DFT are:

i. Separability

ii. Translation

iii. Conjugate symmetry.

iv. Rotation

v. Circular convolution

vi. Correlation

31 What is image translation and scaling?

Translation and scaling are the properties of 2D-DFT

Translation

Image translation is the process of shifting the origin.

$$f(x,y)e^{j2\pi(u_0 x/M + v_0 y/N)} \Leftrightarrow F(u-u_0, v-v_0)$$

$$f(x-x_0, y-y_0) \Leftrightarrow F(u,v)e^{-j2\pi(ux_0/M + vy_0/N)}$$

Scaling

Image scaling is the process of resizing a digital image. Scaling is a non-trivial process that involves a trade-off between efficiency, smoothness and sharpness.

$$af(x,y) \Leftrightarrow aF(u,v)$$

$$f(ax,ay) \Leftrightarrow \frac{1}{|ab|} F(u/a, v/b)$$

Department of Electronics and Communication Engineering

UNIT II- IMAGE ENHANCEMENT

HISTOGRAM EQUALIZATION AND SPECIFICATION

1 List out the categories of image enhancement.

The 2 categories of image enhancement are:

i. Spatial domain enhancement

ii. Frequency domain enhancement.

Spatial domain refers to image plane itself & approaches in this category are based on direct manipulation of picture image.Frequency domain methods based on modifying the image by Fourier transform.

2 What is meant by bit plane slicing?

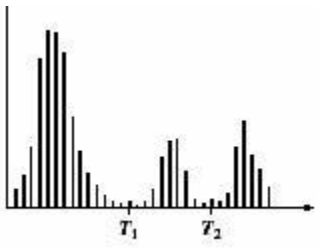
A bit plane of a digital discrete signal (such as image or sound) is a set of bits corresponding to a given bit position in each of the binary numbers representing the signal.For example, for 16-bit data representation there are 16 bit planes: the first bit plane contains the set of the most significant bit, and the 16th contains the least significant bit.

3 Define – Histogram

The histogram of a digital image with gray levels in the range [0, L-1] is a discrete function $h(r_k) = n_k$, where r_k is the kth gray level and n_k is the number of pixels in the image having gray level r_k .

4 What is a multimodal histogram?

A multimodal histogram is the histogram which has two or more dominant modes, i.e probability distribution with two or more modes.



5 Write the objectives of image enhancement technique.

The objectives of enhancement technique is to process an image so that the result is more suitable than the original image for a particular application.

Department of Electronics and Communication Engineering

SPATIAL AVERAGING, DIRECTIONAL SMOOTHING, MEDIAN, GEOMETRIC MEAN, HARMONIC MEAN, CONTRAHARMONIC MEAN FILTERS, HOMOMORPHIC FILTERING

6 List out the different types of derivative filters.

The two types of derivative filters are:

i. First derivative filter-Gradient filter

ii. Second derivative filter-laplacian filter

7 State the principle of directional smoothing.

Directional smoothing is the process used to protect the edges from distortion in the form of blurring while smoothing the images.

8 Define – Geometric Mean Filtering

The geometric mean filter is member of a set of nonlinear mean filters which are better at removing Gaussian type noise and preserving edge features than the arithmetic mean filter. The geometric mean filter is very susceptible to negative outliers. The definition of geometric mean filter is :

$$\hat{f}(x,y) = \left[\prod_{(s,t)\in S_{xy}} g(s,t) \right]^{\frac{1}{mn}}$$

where the coordinate (x, y) is defined over the image f and the coordinate (s,t) is defined over the sub image g.

9 Compare spatial and frequency domain methods.

S.NO	Spatial domain methods	Frequency domain methods
1.	The term spatial domain refers to the image plane itself, and methods in this category are based on direct manipulation of pixels in an image.	Frequency domain processing techniques are based on modifying the Fourier transform of an image
2.	Spatial domain methods are classified into Smoothing spatial filter, Sharpening spatial filter	Frequency domainmethodsare classified into Smoothing frequency filter, Sharpening frequency filter

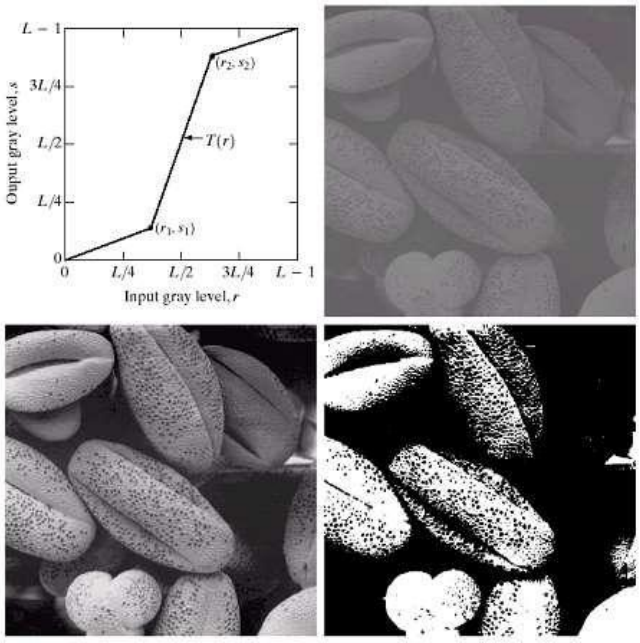
Department of Electronics and Communication Engineering

10 What are the effects of applying Butterworth low pass filter to the noisy image?

The effects of applying Butterworth low pass filter to the noisy image are ringing effect and blurring of the images.

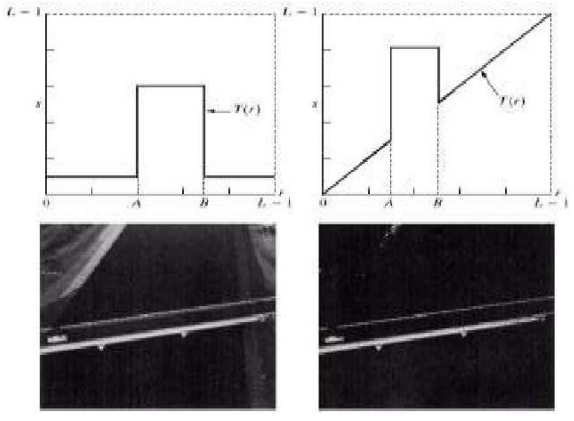
11 What is a contrast stretching?

Contrast stretching is a process that reduces an image of higher contrast than the original by darkening the levels below m and brightening the levels above m in the image.



12 What is gray level slicing?

The gray level slicing is the process of highlighting a specific range of grey levels in an image. Applications are enhancing features such as masses of water in satellite imagery and enhancing flaws in x-ray images.



13 What is the purpose of image averaging?

The purpose of image averaging is to reduce the noise content by adding set of noisy images $g_i(x,y)$

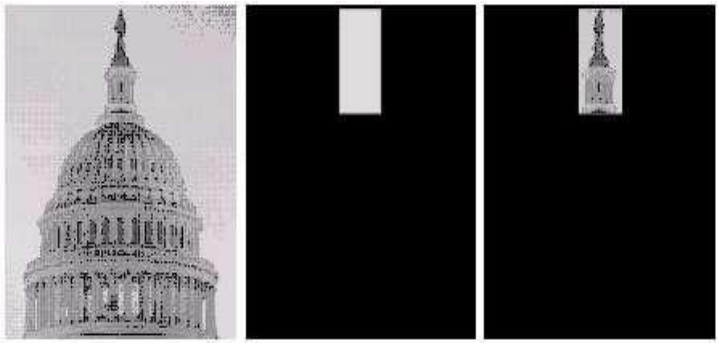
$$\bar{g}(x,y) = \frac{1}{K}\sum_{i=1}^{K} g_i(x,y)$$

K -number of noisy images.

g(x,y) –average of image

14 What is meant by masking?

The process of selecting subimages in an image is called masking. The AND and OR logical operations are used for masking.



Original image AND image mask Result of AND operation

15 Write the steps involved in frequency domain filtering.

i. Preprocessing - Multiply the input image by (-1) to center the transform

ii. Fourier transform - Compute F(u,v), the DFT of the image from (1)

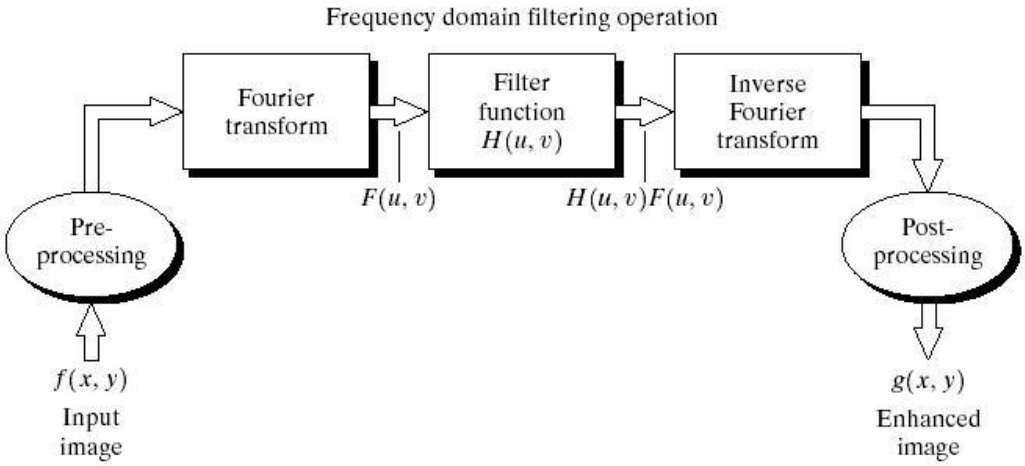
iii. Filtering - Multiply F(u,v) by a filter function H(u,v)

iv. Inverse Fourier Transform - Compute the inverse DFT of the result in (3)

v. Post processing - Obtain the real part of the result in (4)

vi. Multiply the result in (5) by (-1)

Department of Electronics and Communication Engineering



16 What is image negative?

The negative of an image with gray levels in the range [0, L-1] is obtained by using the negative gray level transformation, which is given by the expression,

$$s = L-1-r$$

where r is the input image and s is the output negative image.

17 Define - Spatial Filtering

Spatial filtering is the process of moving the filter mask from point to point in an image. For linear spatial filter, the response is given by a sum of products of the filter

coefficients and the corresponding image pixels in the area spanned by the filter mask.

18 What is meant by median filter?

The median filter replaces the value of a pixel by the median of the gray levels in the neighborhood of that pixel.

e.g: {10,20,20,20,15,20,20,25,100}

step 1: ascending order {10,15,20,20,20,20,20,25,100}

step 2: median gray level is 20.

19 Write the applications of sharpening filters.

The applications of sharpening filters are:

i. Electronic printing

ii. Medical imaging

iii. Industrial application

iv. Autonomous target detection in smart weapons.

UNIT III - IMAGE RESTORATION

1. **What is meant by image restoration?**

   Restoration is a process of reconstructing or recovering an image that has been degraded by noise using a clear knowledge of the degrading phenomenon.

2. **How a degradation process is modeled?**

   A system operator H, with an additive white noise term n(x,y) operates on an input image f(x,y) to produce a degraded image g(x,y).

3. **Differentiate enhancement from restoration.**

   Enhancement technique is based primarily on the pleasing aspects it might present to the viewer. For example: Contrast Stretching

   Restoration technique is based on removal of image blur by applying a deblurrings function .

4. **List out the three methods of estimating the degradation function.**

   The three methods of estimating the degradation function are:

   i. Observation

   ii. Experimentation

   iii. Mathematical modeling

TYPES OF RESTORATION-CONSTRAINED AND UNCONSTRAINED RESTORATION

5. **Why is the restoration called unconstrained restoration?**

   The restoration is called as unconstrained restoration because mostly the restoring process is done without the knowledge of noise present in the function.

6. **What is meant by blind image restoration?**

   Blind image restoration is defined as the process of restoring an image by using an unknown degradation function.

7. **What are the two approaches for blind image restoration?**

   The two approaches for blind image restoration are:

   i. Unconstrained restoration approach

   ii. Constrained restoration approach

INVERSE FILTERING

8. **What are the types of noise models?**

The types of noise models are:

i. Guassian noise

ii. Rayleigh noise

iii. Erlang noise

iv. Exponential noise

v. Uniform noise

vi. Impulse noise

9. **What is inverse filtering?**

The simplest approach to restoration is direct inverse filtering.The inverse filtering divides the transform of the degraded image G(u,v) by the degradation function H(u,v) and determines an approximation of the transform of the original image.

$F^{\wedge}(u,v) = G(u,v)/H(u,v)$

10. **Define -Averaging Filters**

The averaging filters replace each pixel value in an image with the mean (`average') value of its neighbors, including itself. This has the effect of eliminating pixel values which are unrepresentative of their surroundings.

11. **What is pseudo inverse filter?**

The pseudo inverse filter is the stabilized version of inverse filter used for the restoration of degraded images.The Pseudo inverse filter for a linear shift invariant system with frequency response H(u,v) is defined as ,

$H(u,v)=1/(H(u,v)\ H \neq 0$

$= 0 \qquad H=0$

12. **What is meant by Least Mean Square filter?**

The inverse and pseudo inverse filter are very sensitive to noise.The wiener filter known as **Least Mean Square filter** is a method of restoring the images in the presence of blur and noise.

Department of Electronics and Communication Engineering

GEOMETRIC TRANSFORMATION

13. **Define - Geometric Transformation.**

The Geometric transformation is a process used to restore image that has undergone geometric distortion.They recover the original image by modifying the spatial relationships between pixels in an image.

14. **What is meant by rubber sheet transformation?**

Rubber sheet transformation is a geometric transformation viewed as the process of printing an image on a rubber sheet and then stretching the sheet to some predefined set of rules.

15. **Define –Gray Level Interpolation**

The Gray Level Interpolation is a basic operation of geometric transformation .It assigns gray levels to the pixels in the transformed image.

UNIT IV IMAGE SEGMENTATION

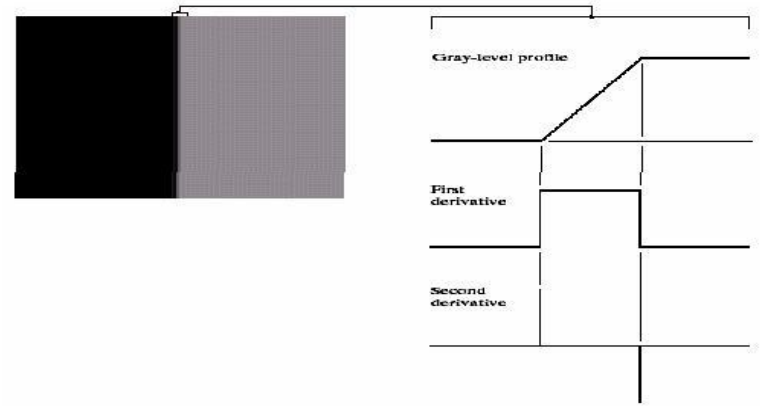
1 Define –Texture

Texture is one of the regional descriptors. It provides measure of properties such as smoothness, coarseness and regularity. There are 3 approaches used to describe the texture of a region. They are:

- Statistical
- Structural
- Spectral

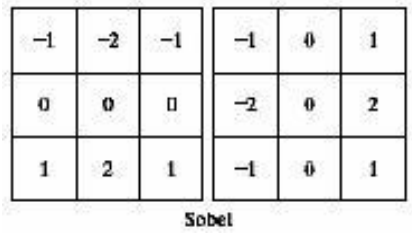
2 How is edge detection is used for detecting discontinuities in a digital image?

Edge detection is the most common approach for detecting meaningful discontinuities in gray level image. The First and the Second order derivatives are used for the detection of edges in an image.



Magnitude of the first order derivative is used to detect edge. The sign of the second order derivative is used to find whether the edge pixels lies on the dark side or light side of an edge.

3 Define – Sobel Operator



The masks shown in above figure are called Sobel operators and are used to implement the following equations.

$$G_x = (z_7 + 2z_8 + z_9) - (z_1 + 2z_2 + z_3)$$

$$G_y = (z_3 + 2z_6 + z_9) - (z_1 + 2z_4 + z_7)$$

Sobel operators are used for computing digital gradients. The Sobel masks have superior noise-suppression characteristics.

4 What are the three types of discontinuity in digital image?

The three basic gray level discontinuities in a digital image are:

i. Points

ii. Lines

iii. Edges

Department of Electronics and Communication Engineering

5 How are the derivatives obtained in edge detection during formulation?

The first derivative at any point in an image is obtained by using the magnitude of the gradient at that point. Similarly the second derivatives are obtained by using the Laplacian transform.

6 What are the two properties used for establishing similarity of edge pixels?

The two properties used for establishing similarity of edge pixels are

i. The strength of the response of the gradient operator used to produce the edge pixel

ii. The direction of the gradient

7 What is an edge?

An edge is a set of connected pixels that lie on the boundary between two regions. Edges are more closely modeled as having a ramp like profile. The slope of the ramp is inversely proportional to the degree of blurring in the edge.

8 List out the properties of the second derivative around an edge.

The properties of the second derivative around an edge are **:**

i. The sign of the second derivative can be used to determine whether an edge pixel lies on the edge.

ii. It produces two values for every edge in an image.

iii. An imaginary straight line joining the extreme positive and negative values of the second derivative would cross zero near the midpoint of the edge.

9 Define –Gradient Operator

First order derivatives of a digital image are based on various approximation of the 2-D gradient. The gradient of an image f(x,y) at location(x,y) is defined as the vector .

Magnitude of the vector is

$f=\text{mag}(f)=[G_x^2+G_y^2]^{1/2}$

$\theta(x,y)=\tan^{-1}(G_y/G_x)$

$\theta(x,y)$ is the direction angle of vector f

10 List out the steps involved in splitting and merging.

The steps involved in splitting and merging are:

i. Split into 4 disjoint quadrants any region R_i for which $P(R_i)$=FALSE.

ii. Merge any adjacent regions R_j and R_k for which $P(R_j \cup R_k)$=TRUE.

iii. Stop when no further merging or splitting is possible

EDGE LINKING VIA HOUGH TRANSFORM,THRESHOLDING

11 What is called global, local and dynamic or adaptive thresholds?

When Threshold T depends only on f(x,y) then the threshold is called global . If T depends both on f(x,y) and p(x,y) is called local. If T depends on the spatial coordinates x and y the threshold is called dynamic or adaptive where f(x,y) is the original image.

REGION BASED GROWING,REGION SPLITTING AND MERGING

12 How is an image identified as an over segmented?

When the segmented image has a large number of potential minima then it is identified as over segmented image. Also many of these minima gives irrelevant detail.

13 What is the principle of region growing based image segmentation?

Region growing is a procedure that groups pixels or sub regions into layer regions based on predefined criteria. The basic approach is to start with a set of seed points and from there grow regions by appending to each seed these neighboring pixels that have properties similar to the seed.

SEGMENTATION BY MORPHOLOGICAL WATERSHEDS ,WATERSHED ALGORITHM

14 What is segmentation?

Segmentation subdivides an image into its constitute regions or objects. The level to which the subdivision is carried depends on the problem being solved .

15 List out the applications of segmentation.

The applications of segmentation are:

i. Pictorial pattern recognition

ii. Scene analysis problems

iii. Motion Estimation

16 What is the use of markers?

Marker is an approach used to control over segmentation. There are two types of markers.They are:

i. Internal marker - Associated with objects of interest

ii. External marker - Associated with background.

17 State the condition to be met by the partitions in region based segmentation.

Let R represent the entire image region. Segmentation process partitions R into n subregions, $R_1, R_2, ..., R_n$

$\cdot U =$ $=1$

ii. R_i is a connected region, $i=1,2..n$

$\cdot \cap = \emptyset$ $\cdot \neq$

iv. $P(R_i)$=TRUE for $i=1,2,..,n$

$\cdot U =$ $\neq$

Here, P(Ri) is a logical predicate defined over the points in set R_i and Φ is a null set.

UNIT V – IMAGE COMPRESSION AND RECOGNITION

1 What is the need for compression?

The capacity of a storage device can be effectively increased with methods that compress a body of data on its way to a storage device and decompresses it when it is retrieved.

2 Define –Compression Ratio

The **Compression Ratio** = original size / compressed size of digital image

3 What is image compression?

Image compression refers to the process of removal of redundancy amount of data required to represent the given quantity of information for digital image. The basis of reduction process is the removal of redundant data.

4 What is data compression?

Data compression requires the identification and extraction of source redundancy.In other words, data compression seeks to reduce the number of bits used to store or transmit information.

5 What are the types of data compression?

The two types of data compression are :

i. Lossless compression –It can recover the exact original data after compression. It is used mainly for compressing database records, spreadsheets or word processing files, where exact replication of the original is essential

ii. Lossy compression –It will result in a certain loss of accuracy in exchange for a substantial increase in compression. Lossy compression is more effective when used to compress graphic images and digitized voice where losses outside visual or aural perception can be tolerated

CODINGS

6 What are the coding systems in JPEG?

The coding systems in JPEG are:

i. A lossy baseline coding system, which is based on the DCT and is adequate for most compression application

ii. An extended coding system for greater compression, higher precision or progressive reconstruction applications

iii. A lossless independent coding system for reversible compression

7 How shift codes are generated?

The shift codes are generated by dividing the symbols into blocks of equal size. The block size is 2k-1 symbols, where k is a positive integer.

8 Write the Hadamard transform matrix H_n for n=3.

$$h_f(x,k) = \begin{cases} (-1)^{b_1(x)b_1(k)+\cdots+b_{n-1}(x)b_{n-1}(k)}, & \text{for even } x \text{ or even } k \\ -(-1)^{b_1(x)b_1(k)+\cdots+b_{n-1}(x)b_{n-1}(k)}, & \text{for odd } x \ \& \text{ odd } k \end{cases}$$

For x=3 and k=3

$$H_3 = \frac{1}{\sqrt{3}} \begin{bmatrix} + & + & + \\ + & - & + \\ + & + & - \end{bmatrix}$$

9 What is interpixel redundancy?

Interpixel redundancy is another form of data redundancy, which is related to interpixel correlation within an image. Usually the value of certain pixel in the image can be reasonably predicted from the values of group of other pixels in the image.

10 Define –Coding Redundancy

If the gray level of an image is coded in a way that uses more code words than necessary to represent each gray level, then the resulting image is said to contain coding redundancy.

11 What is run length coding?

Run-length Encoding, or RLE is a technique used to reduce the size of a repeating string of characters. This repeating string is called a *run*; typically RLE encodes a run of symbols into two bytes, a count and a symbol. RLE can compress any type of data regardless of its information content, but the content of data to be compressed affects the compression ratio. Compression is normally measured with the compression ratio:

12 Define –Psycho Visual Redundancy

In normal visual processing certain information has less importance than other information. So this information is said to be psycho visual redundant.

13 Define –Encoder

Source Encoder is responsible for removing the coding and interpixel redundancy and psycho visual redundancy.

There are two components .They are:

i. Source Encoder

ii. Channel Encoder

14 Define –Source Encoder

Source encoder performs three operations

i. Mapper -this transforms the input data into non-visual format. It reduces the interpixel redundancy

ii. Quantizer - It reduces the psycho visual redundancy of the input images .This step is omitted if the system is error free

iii. Symbol encoder- This reduces the coding redundancy.This is the final stage of encoding process

15 Define –Channel Encoder

The channel encoder reduces the impact of the channel noise by inserting redundant bits into the source encoded data.

e.g: Hamming code

16 What are the types of decoder?

The types of decoder are:

i. Symbol decoder- This performs inverse operation of symbol encoder

ii. Inverse mapping- This performs inverse operation of mapper

iii. Channel decoder-this is omitted if the system is error free

17 What are the operations performed by error free compression?

The operations performed by error free compression are:

i. Devising an alternative representation of the image in which its inter pixel redundancy is reduced.

ii. Coding the representation to eliminate coding redundancy

18 What is Variable Length Coding?

Variable Length Coding is the simplest approach to error free compression. It reduces only the coding redundancy. It assigns the shortest possible codeword to the most probable gray levels.

Department of Electronics and Communication Engineering

19 Define – Huffman Coding

Huffman coding is a popular technique for removing coding redundancy. When coding the symbols of an information source the Huffman code yields the smallest possible number of code words, code symbols per source symbol.

20 Define –I frame

I-frame is Intraframe or Independent frame. An I-frame is compressed independently of all frames. It resembles a JPEG encoded image. It is the reference point for the motion estimation needed to generate subsequent P-frame.

21 Define–P frame

P-frame is called predictive frame. A P-frame is the compressed difference between the current frame and a prediction of it based on the previous I or P-frame.

JPEG AND MPEG STANDARDS

22 What is JPEG?

The acronym is expanded as "Joint Photographic Expert Group". It is an international standard in 1992. It perfectly Works with color and grayscale images, and has many applications e.g., satellite, medical.

23 What are the basic steps used in JPEG?

The basic steps in JPEG are

i. Image Preparation (Separation into Components)

ii. Transformation (DCT: Discrete Cosine Transform)

iii. Quantization (Weighting of the Contents)

iv. Entropy Coding (Huffman Coding)

v. Elimination of redundant information

24 What is MPEG?

The acronym is expanded as "Moving Picture Expert Group". It is an international standard in 1992. It perfectly Works with video and also used in teleconferencing input image.

1. What is pattern?

Pattern is a quantitative or structural description of an object or some other entity of interest in an image. It is formed by one or more descriptors.

2. What is pattern class?

It is a family of patterns that share some common properties. Pattern classes are denoted as w1 w2 w3 …… wM , where M is the number of classes.

3. What is pattern recognition?

It involves the techniques for arranging pattern to their respective classes by automatically and with a little human intervention.

4. What are the three principle pattern arrangements?

The three principal pattern arrangements are vectors, Strings and trees. Pattern vectors are represented by old lowercase letters such as x y z and In the form x=[x1, x2, ……., xn]

Each component x represents I th descriptor and n is the number of such descriptor

5. Define – Chain code

Chain codes are used to represent a boundary by a connected sequence of straight line segment of specified length and direction. Typically this representation is based on 4 or 8 connectivity of segments. The direction of each segment is coded by using a numbering scheme.

6. What are the demerits of chain code?

The demerits of chain code are,

(i) The resulting chain code tends to be quite long.

(ii) Any small disturbance along the boundary due to noise cause changes in the code that may not be related to the shape of the boundary.

7. What is polygonal approximation method?

Polygonal approximation is a image representation approach in which a digital boundary can be approximated with arbitary accuracy by a polygon. For a closed curve the approximation is exact when the number of segments in polygon is equal to the number of points in the boundary so that each pair of adjacent points defines a segment in the polygon.

8. Specify the various polygonal approximation methods.

The various polygonal approximation methods are

(i) Minimum perimeter polygons.
(ii) Merging techniques.
(iii)Splitting techniques.

9. Name few boundary descriptors.

(i) Simple descriptors.
(ii) Shape descriptors.
(iii) Fourier descriptors.

10. Define – Length of a boundary

The length of a boundary is the number of pixels along a boundary. Example, for a chain coded curve with unit spacing in both directions, the number of vertical and horizontal components plus $\sqrt{2}$ times the number of diagonal components gives its exact length.

Department of Electronics and Communication Engineering

11. Define – Shape numbers

Shape number is defined as the first difference of smallest magnitude. The order n of a shape number is the number of digits in its representation.

12. Name few measures used as simple descriptors in region descriptors.

1. Area.
2. Perimeter.
3. Mean and median gray levels
4. Minimum and maximum of gray levels.
5. Number of pixels with values above and below mean.

13. Define – Texture

Texture is one of the regional descriptors. It provides measure measures of properties such as smoothness, coarseness and regularity.

14. Define – Compactness

Compactness of a region is defined as $(\text{perimeter})^2$ / area. It is a dimensionless quantity and is insensitive to uniform scale changes.

15. List the approaches to describe texture of a region.

The approaches to describe the texture of a region are,

(i) Statistical approach.

(ii) Structural approach.

(iii) Spectural approach.

16. What is global, local and dynamic or adaptive threshold?

When threshold T depends only on f(x,y) then the threshold is called global. If T depends both on f(x,y) and p(x,y) then it is called local. If T depends on the spatial coordinates x and y , the threshold is called dynamic or adaptive where f(x,y) is the original image.

Department of Electronics and Communication Engineering