

SNS COLLEGE OF TECHNOLOGY (An Autonomous Institution)

Coimbatore – 35.



DEPARTMENT OF BIOMEDICAL ENGINEERING

19BMB304 – BIOMEDICAL IMAGE PROCESSING

2 MARKS - UNIT-I

1. Define Image?

An Image may be defined as a two dimensional function f(x,y) where x & y are spatial (plane) coordinates, and the amplitude of f at any pair of coordinates(x,y) is called intensity or gray level of the image at that point. When x,y and the amplitude values of f are all finite, discrete quantities we call the image as Digital Image.

2. Define Image Sampling?

Digitization of spatial coordinates (x,y) is called Image Sampling. To be suitable for computer processing, an image function f(x,y) must be digitized both spatially and in magnitude.

3. Define Quantization ?

Digitizing the amplitude values is called Quantization. Quality of digital image is determined to a large degree by the number of samples and discrete gray levels used in sampling and quantization.

4. 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.

5. Define Mach band effect?

The spatial interaction of Luminance from an object and its surround creates a Phenomenon called the mach band effect.

6. Define Brightness?

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

7. Define Tapered Quantization?

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

8. What do you meant by Gray level?

Gray level refers to a scalar measure of intensity that ranges from black to grays and finally to white.

9. What do you meant by Color model?

A Color model is a specification of 3D-coordinates system and a subspace with in that system where each color is represented by a single point.

10. List the hardware oriented color models?

- RGB model
- CMY model
- YIQ model
- HSI model

11. What is Hue of saturation?

Hue is a color attribute that describes a pure color where saturation gives a measure of the degree to which a pure color is diluted by white light.

12. List the applications of color models?

1. RGB model--- used for color monitor & color video camera

- 2. CMY model---used for color printing
- 3. HIS model--- used for color image processing
- 4. YIQ model---used for color picture transmission

13. What is Chromatic Adoption?

The hue of a perceived color depends on the adoption of the viewer. For example, the American Flag will not immediately appear red, white, and blue of the viewer has been subjected to high intensity red light before viewing the flag. The color of the flag will appear to shift in hue toward the red component cyan.

14. Define Resolution?

Resolution is defined as the smallest number of discernible detail in an image. Spatial resolution is the smallest discernible detail in an image and gray level resolution refers to the smallest discernible change is gray level.

15.Define of KL Transform?

KL Transform is an optimal in the sense that it minimizes the mean square error between the vectors X and their approximations X[^]. Due to this idea of using the Eigenvectors corresponding to largest Eigen values. It is also known as principal component transform.

16.Explain Mask or Kernels?

A Mask is a small two-dimensional array, in which the value of the mask coefficient determines the nature of the process, such as image sharpening.

17. What are the steps involved in DIP?

1. Image Acquisition 2. Preprocessing 3. Segmentation 4. Representation and Description 5. Recognition and Interpretation

18. Differentiate photopic and scotopic vision?

Photopic vision	Scotopic vision	
1. The human being can resolve the fine details with these cones because each one is connected to its own perve end	Several rods are connected to one nerve end. So it gives the overall picture of the image.	
2. This is also known as bright light vision.	This is also known as thin light vision.	

19. Define subjective brightness and brightness adaptation?

Subjective brightness means intensity as preserved by the human visual system. Brightness adaptation means 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.

20. Define weber ratio

The ratio of increment of illumination to background of illumination is called as weber ratio. Ic/I. If the ratio is small, then small percentage of change in intensity is needed (ie) good brightness adaptation. If the ratio is large, then large percentage of change in intensity is needed (ie) poor brightness adaptation.

21. What is meant by machband effect?

Machband effect means the intensity of the stripes is constant. Therefore it preserves the brightness pattern near the boundaries, these bands are called as machband effect.

22. What is simultaneous contrast?

The region reserved brightness not depends on its intensity but also on its background. All centre square have same intensity. However they appear to the eye to become darker as the background becomes lighter.

23. What is meant by illumination and reflectance?

Illumination is the amount of source light incident on the scene. It is represented as i(x, y). Reflectance is the amount of light reflected by the object in the scene. It is represented by r(x, y).

24. Define sampling and quantization

Sampling means digitizing the co-ordinate value (x, y).

Quantization means digitizing the amplitude value.

25. Find the number of bits required to store a 256 X 256 image with 32 gray levels?

32 gray levels = 2^5 = 5 bits 256 * 256 * 5 = 327680 bits.

26. Write the expression to find the number of bits to store a digital image?

The number of bits required to store a digital image is

b=M X N X k

When M=N, this equation becomes

b=N^2k



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2 MARKS - UNIT-II

1. What is meant by spatial averaging?

In spatial or image averaging each pixel in an image is repalced by a weighted average of its

neighborhood pixels. This process is used to reduce the noise content in an image.

2. What is directional smoothing?

directional smoothing is the process used to protect the edges from distortions in the form of blurring

while smoothing the images. It is done by using directional averaging filters.

3. What is a Median filter?

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

neighborhood of that pixel

4. Name the categories of Image Enhancement and explain?

The categories of Image Enhancement are

- Spatial domain
- Frequency domain

Spatial domain: It refers to the image plane, itself and it is based on direct manipulation of

pixels of an image.

Frequency domain techniques are based on modifying the Fourier transform of an image.

5. Define box filter.

A spatial averaging filter in which all the coefficients are equal is called as a box filter. An example 3×3 filter is,

1	1	1
1	1	1
1	1	1

6. What is homomorphic filtering?

The filter which controls both high frequency and low frequency components are called as homomorphic filters. The equation for homomorphic filter can be derived from the illumination reflectance model given by the equation.

f(x, y) = i(x, y) r(x, y)

7. What is histogram specification?

The method used to generate a processed image that has a specified histogram is called histogram matching (or) histogram specification. It is useful to specify the shape of the histogram that we wish the processed image to have.

8. What is histogram equalization?

A technique used to obtain a uniform histogram is known as histogram equalization. Pr(rk) Vs rk is called as histogram equalization, where

Pr(rk) = nk / n

nk - no of pixels in the image having gray level rk

n- total no . of pixels.

Conditions:

T(r) is single valued and monotonically increasing in interval $0 \le r \le 1$, $0 \le T(r) \le 1$

9. Specify the objective of image enhancement technique.

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

10. What is contrast stretching?

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

11. What is grey level slicing?

Highlighting a specific range of grey levels in an image often is desired. Applications include enhancing features such as masses of water in satellite imagery and enhancing flaws in x-ray images.

12. Define image subtraction.

The difference between 2 images f(x,y) and h(x,y) expressed as, g(x,y)=f(x,y)-h(x,y) is obtained by computing the difference between all pairs of corresponding pixels from f and h.

13. What is the purpose of image averaging?

The purpose of image averaging is to remove the noise from the image. An important application of image averaging is in the field of astronomy, where imaging with very low light levels is routine, causing sensor noise frequently to render single images virtually useless for analysis.

14. What is meant by masking?

Mask is the small 2-D array in which the values of mask co-efficient determines the nature of process. The enhancement technique based on this type of approach is referred to as mask processing.

15. Give the formula for negative and log transformation.

Negative: S=L-1-r Log: $S = c \log(1+r)$ Where c-constant and r 0

16. What is meant by bit plane slicing?

Instead of highlighting gray level ranges, highlighting the contribution made to total image appearance by specific bits might be desired. Suppose that each pixel in an image is represented by 8 bits. Imagine that the image is composed of eight 1-bit planes, ranging from bit plane 0 for LSB to bit plane-7 for MSB.

17. What is meant by histogram equalization?

The transformation used to convert low contrast image into high contrast image that has uniform histogram is called histogram equalization.

18. Differentiate linear spatial filter and non-linear spatial filter

linear spatial filter

Response is a sum of products of the filter co-efficient.

non-linear spatial filter

They do not explicitly use coefficients in the sum-of-products.

19.what is high boost filtering?

High boost=(A-1)(original)+highpass

20.Define Laplacian filter for two variables?

2f(x,y)=f(x+1,y)+f(x-1,y)+f(x,y+1)+f(x,y-1)-4f(x,y)

21.What is called pseudocolor image processing?

It is also known as false color image processing. In some cases there is no color concept for a gray scale image, But we can assign false color to an image.

22. Give the formula for transform function of a Butterworth low pass filter.

The transfer function of a Butterworth low pass filter of order n and with cut off frequency at a distance D0 from the origin is, 2n

 $H(u,v) = 1 / 1 + [D(u,v)^{2} / D0^{2}]^{1/2}$

Where D(u,v) = [(u - M/2) + (v-N/2)]

23. What do you mean by Point processing?

Image enhancement at any Point in an image depends only on the gray level at that point is often referred to as Point processing.

24. What is Image Negatives?

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

s = L-1-r

Where s is output pixel r is input pixel

25. Explain 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.

26. What is a Median filter?

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

27. What is maximum filter and minimum filter?

The 100th percentile is maximum filter is used in finding brightest points in an image. The 0th percentile filter is minimum filter used for finding darkest points in an image.

28. Write the application of sharpening filters?

1. Electronic printing and medical imaging to industrial application

2. Autonomous target detection in smart weapons.

29. Name the different types of derivative filters?

- 1. Perwitt operators
- 2. Roberts cross gradient operators
- 3. Sobel operators

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2 MARKS - UNIT-III

1. What is meant by Image Restoration?

Restoration attempts to reconstruct or recover an image that has been degraded by using a clear knowledge of the degrading phenomenon.

2. What are the two properties in Linear Operator?

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Additivity - H[f1(x,y)+f2(x,y)]=H[f1(x,y)]+H[f2(x,y)]
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The additive property says that if H is the linear operator, the response to a sum of two is equal to the sum of the two responses.

Homogenity - H[k1f1(x,y)] = k1 H[f1(x,y)]

The homogeneity property says that, the response to a constant multiple of any input is equal to the response to that input multiplied by the same constant.

3. How a degradation process is modeled?

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

4. Give the relation for degradation model for continuous function?



g(x,y)=f(x,y)*h(x,y)+h(x,y)

5. What are the types of noise models?

- Guassian noise
- Rayleigh noise
- Erlang noise
- Exponential noise
- Uniform noise

6. What is inverse filtering?

The simplest approach to restoration is direct inverse filtering, an estimate $F^{(u,v)}$ of the transform of the original image simply by dividing the transform of the degraded image $G^{(u,v)}$ by the degradation function.

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

7. What is pseudo inverse filter?

It is the stabilized version of the inverse filter. For a linear shift invariant system with frequency response H(u,v) the pseudo inverse filter is defined as G(u,v)=1/(H(u,v), $H(u,v) \ge 0$, $H(u,v) \le 0$.

8. What is meant by least mean square filter?

The limitation of inverse and pseudo inverse filter is very sensitive noise. The wiener filtering is a method of restoring images in the presence of blurr as well as noise.

9. Give the difference between Enhancement and Restoration?

Enhancement technique is based primarily on the pleasing aspects it might present to the viewer. For example: Contrast Stretching. Where as Removal of image blur by applying a deblurrings function is considered a restoration technique.

10. Give the relation of following noise?





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2 MARKS - UNIT-IV

1. What is image compression?

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

2. 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.

3. What are two main types of Data compression?

Lossless compression 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.

Lossy compression 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 digitised voice where losses outside visual or aural perception can be tolerated.

4. What is the need for Compression?

In terms of storage, 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.

In terms of communications, the bandwidth of a digital communication link can be effectively increased by compressing data at the sending end and decompressing data at the receiving end.

At any given time, the ability of the Internet to transfer data is fixed. Thus, if data can effectively be compressed wherever possible, significant improvements of data throughput can be achieved. Many files can be combined into one compressed document making sending easier.

5. What are dIfferent Compression Methods?

Run Length Encoding (RLE) Arithmetic coding

Huffman coding and Transform coding

6. 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.

7. Define interpixel redundancy?

The value of any given pixel can be predicted from the values of its neighbors.

The information carried by is small. Therefore the visual contribution of a single pixel to an image is redundant. Otherwise called as spatial redundant geometric redundant or

8. 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.

9. Define compression ratio.

Compression is normally measured with the compression ratio:

Compression Ratio = original size / compressed size: 1

10. 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.

11. Define encoder

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

There are two components

A) Source Encoder B) Channel Encoder

12. Define source encoder

Source encoder performs three operations

- Mapper -this transforms the input data into non-visual format. It reduces the interpixel redundancy.
- Quantizer It reduces the psycho visual redundancy of the input images .This step is omitted if the system is error free.
- Symbol encoder- This reduces the coding redundancy .This is the final stage of encoding process.

13. Define channel encoder

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

14. What are the types of decoder?

Source decoder- has two components

a) Symbol decoder- This performs inverse operation of symbol encoder. b) Inverse mapping-This performs inverse operation of mapper. Channel decoder-this is omitted if the system is error free.

15. What are the operations performed by error free compression?

- Devising an alternative representation of the image in which its interpixel redundant are reduced.
- Coding the representation to eliminate coding redundancy.

16. 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.

17. 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.

18. Define Block code

Each source symbol is mapped into fixed sequence of code symbols or code words. So it is called as block code.

19. Define instantaneous code

A code word that is not a prefix of any other code word is called instantaneous or prefix codeword.

20. Define uniquely decodable code

A code word that is not a combination of any other codeword is said to be uniquely decodable code.

21. Define B2 code

Each code word is made up of continuation bit c and information bit which are binary numbers. This is called B2 code or B code. This is called B2 code because two information bits are used for continuation bits

22. Define the procedure for Huffman shift

List all the source symbols along with its probabilities in descending order.

Divide the total number of symbols into block of equal size. Sum the probabilities of all the source symbols outside the reference block. Now apply the procedure for reference block, including the prefix source symbol. The code words for the remaining symbols can be constructed by means of one or more prefix code followed by the reference block as in the case of binary shift code.

22a. What is the limitation of Huffman coding?

- Huffman code is optimal only if exact probability distribution of the source symbols is known.
- Each symbol is encoded with integer number of bits.
- Huffman coding is not efficient to adapt with the changing source statistics.
- The length of the codes of the least probable symbol could be very large to store into a single word or basic storage unit in a computing system

23. Define arithmetic coding

In arithmetic coding one to one corresponds between source symbols and code word doesn't exist where as the single arithmetic code word assigned for a sequence of source symbols. A code word defines an interval of number between 0 and 1.

24. What is bit plane Decomposition?

An effective technique for reducing an image's interpixel redundancies is to

process the image's bit plane individually. This technique is based on the concept of decomposing multilevel images into a series of binary images and compressing each binary image via one of several well-known binary compression methods.

25. What are three categories of constant area coding?

The three categories of constant area coding are

All white All black Mixed intensity

The most probable or frequency occurring is assign a 1 bit code '0', other two categories area assigned as 2 bit code '10' and '11'

27. How effectiveness of quantization can be improved?

Introducing an enlarged quantization interval around zero, called a dead zero.

Adapting the size of the quantization intervals from scale to scale. In either case, the selected quantization intervals must be transmitted to the decoder with the encoded image bit stream.

28. What are the coding systems in JPEG?

- A lossy baseline coding system, which is based on the DCT and is adequate for most compression application.
- An extended coding system for greater compression, higher precision or progressive reconstruction applications.
- A lossless independent coding system for reversible compression.

29. 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, Many applications e.g., satellite, medical,...

30. What are the basic steps in JPEG?

The Major Steps in JPEG Coding involve:

- DCT (Discrete Cosine Transformation)
- Quantization

- DPCM on DC component
- RLE on AC Components

antization

• Entropy Coding

Zigzag Scan31. 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 Wavelet transform Quantizer.



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2 MARKS - UNIT-V

1. Define chain codes?

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 the segments. The direction of each segment is coded by using a numbering scheme.

2. What are the demerits of chain code?

- The resulting chain code tends to be quite long.
- 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.

3. What is thinning or skeletonizing algorithm?

An important approach to represent the structural shape of a plane region is to reduce it to a graph. This reduction may be accomplished by obtaining the skeletonizing algorithm. It play a central role in a broad range of problems in image processing, ranging from automated inspection of printed circuit boards to counting of asbestos fibres in air filter.

4. Specify the various image representation approaches

- Chain codes
- Polygonal approximation
- Signatures
- Boundary segments

5. 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.

6 Specify the various polygonal approximation methods

- Minimum perimeter polygons
- Merging techniques Splitting techniques

7. Name few boundary descriptors

• Simple descriptors – Length, curvature, Major Axis, Minor Axis, Perimeter

- Shape numbers
- Fourier descriptors

8. Give the formula for diameter of boundary

The diameter of a boundary B is defined as

$$Diam(B) = \max_{i,j}[D(pi, pj)]$$

D-distance measure, pi,pj- points on the boundary

9. Define length of a boundary.

The length of a boundary is the number of pixels along a boundary.Eg.for a chain coded curve with unit spacing in both directions the number of vertical and horizontal components plus _2 times the number of diagonal components gives its exact length.

10) List the approaches to describe the texture of the region

- Relative smoothness
- Measure of uniformity $R = \frac{1}{1 + \sigma^{2}(z)}$ • Measure of uniformity $U(z) = \sum_{i=0}^{L-1} p^{2}(z_{i})$
- Average entropy

$$e(z) = -\sum_{i=0}^{L-1} p(z_i) \log_2 p(z_i)$$