QUESTION BANK

Name of the Department : Electronics and Communication Engineering

Subject Code & Name : DS4151 & Digital Image and Video Processing

Year & Semester : II & III (M.E-VLSI Design)

UNIT – I

FUNDAMENTALS OF IMAGE PROCESSING AND TRANSFORMS

PART – A

1. Define Image.

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

2. 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.

3. 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.

4. 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.

5. 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.

6. What do you meant by Color model?

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.

7. List the hardware oriented color models.

* RGB model

* CMY model

* YIQ model

* HSI model

8. 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.

9. List the applications of color models.

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

CMY model---used for color printing

HIS model----used for color image processing

YIQ model---used for color picture transmission

10. 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.

11. Define Resolutions.

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.

12. What is meant by pixel?

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 pels elements.

13. Define Digital image.

When x, y and the amplitude values of f all are finite discrete quantities, we call the image digital image.

14. What are the steps involved in DIP?

Image Acquisition

Preprocessing

Segmentation

Representation and Description

Recognition and Interpretation

15. What is recognition and Interpretation?

Recognition means is a process that assigns a label to an object based on the information provided by its descriptors. Interpretation means assigning meaning to a recognized object.

16. Specify the elements of DIP system.

Image Acquisition

Storage

Processing and Display

17. List the categories of digital storage.

Short term storage for use during processing.

Online storage for relatively fast recall.

Archical storage for infrequent access.

18. What are the types of light receptors?

The two types of light receptors are

Cones and

Rods

19. Differentiate photopic and scotopic vision.

S.No	Photopic Vision	Scotopic Vision
1.	The human being can resolve the fine details with these cones. Because each cone is connected to own nerve end.	Several rods are connected to one nerve end. So it gives the overall picture of the image.
2.	Bright light vision.	Thin light vision.

20. 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.

21. 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.

22. Define weber ratio.

The ratio of increment of illumination to background of illumination is called as weber ratio, ie, $\Delta i/i$. If the ratio $(\Delta i/i)$ is small, then small percentage of change in intensity is needed.ie,

good brightness adaption. If the ratio (Δi/i) is large, then large percentage of change in intensity is needed.ie, poor brightness adaption.

23. 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.

24. What is simultaneous contrast?

The region reserved brightness not depend 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.

25. 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).

26. Define sampling and quantization.

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

Quantization means digitizing the amplitude value.

27. 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.

28. 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*N*K

When, M=N, this equation becomes, b=M^2*K

29. What do you meant by Zooming of digital images?

Zooming may be viewed as over sampling. It involves the creation of new pixel locations and the assignment of gray levels to those new locations.

30. What do you meant by shrinking of digital images?

Shrinking may be viewed as under sampling. To shrink an image by one half, we delete every row and column. To reduce possible aliasing effect, it is a good idea to blue an image slightly before shrinking it.

31. Explain the types of connectivity.

4 connectivity

8 connectivity

M connectivity (mixed connectivity)

32. What is meant by path?

Path from pixel p with co-ordinates (x, y) to pixel q with co-ordinates (s,t) is a sequence of distinct pixels with co-ordinates.

33. Define the term Luminance.

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

34. What is geometric transformation?

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

The basic geometric transformations are

Image translation

Scaling and Image rotation

35. What is image translation and scaling?

Image translation means reposition the image from one co-ordinate location to another along straight line path.

Scaling is used to alter the size of the object or image (ie) a co-ordinate system is scaled by a factor.

36. What is the need for transform?

The need for transform is most of the signals or images are time domain signal

(ie) signals can be measured with a function of time. This representation is not always best. For most image processing applications anyone of the mathematical transformation are applied to the signal or images to obtain further information from that signal.

37. What is Image Transform?

An image can be expanded in terms of a discrete set of basis arrays called basis images. These basis images can be generated by unitary matrices. Alternatively, a given NxN image can be viewed as an N^2x1 vectors. An image transform provides a set of coordinates or basis vectors for vector space.

38. What are the applications of transform?

To reduce band width

To reduce redundancy

To extract feature.

39. Give the Conditions for perfect transform.

Transpose of matrix = Inverse of a matrix.

Orthoganality.

40. What are the properties of unitary transform?

Determinant and the Eigen values of a unitary matrix have unity magnitude

The entropy of a random vector is preserved under a unitary Transformation

Since the entropy is a measure of average information, this means information is preserved under a unitary transformation.

41. Specify the properties of 2D Fourier transform.

The properties are,

1. Separability
2. Translation
3. Periodicity and conjugate symmetry
4. Rotation
5. Distributivity and scaling
6. Average value
7. Laplacian
8. Convolution and correlation

42. Explain separability property in 2D Fourier transform

The advantage of separable property is that F(u,v) and f(x,y) can be obtained by successive application of 1-D fourier transform (or) its inverse,

$$F(u,v) = [1/N] \Sigma F(x,v) e^{-j2\pi ux/N}$$

Where,

$F(x,v) = N\{[1/N] \Sigma f(x,y) e^{-j2\pi vy/N}\}$

43. Properties of twiddle factor.

(1) Periodicity : $W_N(k+N)=W_Nk$

(2) Symmetry : $W_N(k+N/2)= -W_Nk$

44. Give the Properties of two-dimensional DFT.

* Symmetric
* Periodic extensions
* Sampled Fourier transform
* Conjugate symmetry.

45. What is meant by convolution?

The convolution of two functions is defined by, $f(x)*g(x)=f(\alpha).g(x-\alpha)d\alpha$

Where, $\alpha \rightarrow$ dummy variable

PART – B

1. Explain the elements of digital image processing system with a neat diagram.
2. Write short notes on 2D DFT transform and its properties.
3. Explain about image sampling and quantization with neat sketch.
4. Describe about Walsh transform, Hadamard transform, Haar transform and KL transform.
5. Write short notes on working principle of digital camera.
6. Compare different image transforms in detail.

UNIT II

ENHANCEMENT AND RESTORATION

PART – A

1. 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.

2. Explain the 2 categories of image enhancement.

i) Spatial domain refers to image plane itself & approaches in this category are based on direct manipulation of picture image.

ii) Frequency domain methods based on modifying the image by fourier transform.

3. 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.

4. 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.

5. Define image subtraction.

The difference between two 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.

6. What is the purpose of image averaging?

An important application of image averagingis 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.

7. 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.

8. Give the formula for negative and log transformation.

Negative : s=L-1-r

Log : s=c log(1+r)

Where, C→ constant & r≥0

9. 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.

10. 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 → k-th gray level.

n_k → number of pixels in the image having gray level r_k.

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

S.No	Linear Spatial filter	Non-linear spatial filter
1.	Response is a sum of products of the filter co-efficient.	They do not explicitly use co-efficients in the sum of products.
2.	R=w(-1,-1) f(x-1,y-1) + w(-1,0) f(x-1,y) + … + w(0,0) f(x,y) + … + w(1,0) f(x+1,y) + w(1,1) f(x+1,y+1)	R=w1z1+w2z2+ … + w9z9

12. Give the mask used for high boost filtering.

0	-1	0
-1	A+4	-1
0	-1	0

-1	-1	-1
-1	A+8	-1
-1	-1	-1

13. What is meant by laplacian filter?

The laplacian for a function f(x,y) of two variables is, $\nabla^2 f = \partial^2 f/\partial x^2 + \partial^2 f/\partial y^2$

14. Write the steps involved in frequency domain filtering.

(1) Multiply the input image $(-1)^{x+y}$ to enter the transform.

(2) Compute F(u,v), the DFT of the image from (1).

(3) Multiply F(u,v) by a filter function H(u,v).

(4) Compute the inverse DFT of the result in (3).

(5) Obtain the real part of the result in (4).

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

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

The transfer function of a Butterworth LPF of order n & with cut-off frequency at a distance Do from the origin is,

$$H(u,v)= 1/\{1+[D(u,v)/Do]^{2n}\} \quad \text{Where, } D(u,v)=(u-M/2)^2+(v-m/2)^2$$

16. 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.

17. 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,

s=L-1-r, s→output pixel and r→input pixel

18. Define Derivative filter.

For a function f(x,y) the gradient f at co-ordinate (x,y) is,

$$\Delta f = mag(\Delta f) = \{(\eth f/\eth x)^2 + (\eth f/\eth y)^2\}^{0.5}$$

19. 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.

20. 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.

21. 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.

22. Write the application of sharpening filters.

* Electronic printing and medical imaging to industrial application
* Autonomous target detection in smart weapons.

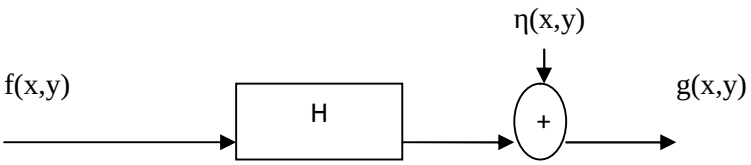
23. Name the different types of derivative filters?

* Perwitt operators
* Roberts cross gradient operators
* Sobel operators

24. 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.

25. How a degradation process is modeled?



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

26. Why the restoration is called as unconstrained restoration?

In the absence of any knowledge about the noise η, a meaningful criterion function is to seek an f^ such that, Hf^ approximates of in a least square sense by assuming the noise term is as small as possible. Where, H→system operator.

f^→estimated input image. g→degraded image.

27. Which is the most frequent method to overcome the difficulty to formulate the spatial relocation of pixels?

The point is the most frequent method, which are subsets of pixels whose location in the input (distorted) and output (corrected) imaged is known precisely.

28. What are the three methods of estimating the degradation function?

Observation
Experimentation
Mathematical modeling.

29. 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.

PART – B

1. Explain on spatial domain methods in detail.
2. Discuss in detail about Histogram processing.
3. Write short notes on image restoration/degradation model & color image enhancement.
4. Explain about smoothing and sharpening frequency domain filters.
5. Discuss in detail about blind deconvolution.
6. Explain about smoothing and sharpening spatial filters.

UNIT III

SEGMENTATION AND RECOGNITION

1. What is segmentation?

Segmentation subdivides on image in to its constitute regions or objects. The level to which the subdivides is carried depends on the problem being solved .That is segmentation should when the objects of interest in application have been isolated.

2. Write the applications of segmentation.

* Detection of isolated points.
* Detection of lines and edges in an image.

3. What are the three types of discontinuity in digital image?

Points, lines and edges.

4. How the derivatives are 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.

5. Write about linking edge points.

The approach for linking edge points is to analyze the characteristics of pixels in a small neighborhood (3x3 or 5x5) about every point (x,y)in an image that has undergone edge detection. All points that are similar are linked, forming a boundary of pixels that share some common properties.

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

(A) The strength of the response of the gradient operator used to produce the edge pixel.

(B) The direction of the gradient.

7. What is edge?

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

8. Give the properties of the second derivative around an edge.

* The sign of the second derivative can be used to determine whether an edge pixel lies on the dark or light side of an edge.
* It produces two values for every edge in an image.
* An imaginary straightline 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,

$\Delta f=mag(\Delta f) =[Gx^2+Gy^2]^{0.5}$

$\alpha(x,y)=\tan^{-1}[Gy/Gx]$ → Direction angle of vector Δf.

10. What is meant by object point and background point?

To execute the objects from the background is to select a threshold T that separate these modes. Then any point (x,y) for which f(x,y)>T is called an object point. Otherwise the point is called background point.

11. 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) 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.

12. Define region growing.

Region growing is a procedure that groups pixels or subregions in to 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 neighbouring pixels that have properties similar to the seed.

13. Specify the steps involved in splitting and merging.

Split into 4 disjoint quadrants any region Ri for which P(Ri)=False. Merge any adjacent regions Ri&Rk for which P(RjURk)=True. Stop when no further merging (or) splitting is positive.

14. 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.

15. 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.

16. 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.

17. Specify the various image representation approaches.

- Chain codes
- Polygonal approximation
- Boundary segments

18. 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.

19. Specify the various polygonal approximation methods.

- Minimum perimeter polygons
- Merging techniques
- Splitting techniques

20. Write about boundary segments.

Decomposing a boundary into segments often is useful. Decomposition reduces the boundary's complexity and thus simplifies the description process.This approach is particularly attractive when the boundary contains one or more significant concavities that carry shape information.In this case use of the convex hull of the region enclosed by the boundary is a powerful tool for robust decomposition of the boundary.

PART – B

1.Describe the edge detection in detail.

2.Discuss about region based image segmentation techniques.

3.Discuss about morphological processing in detail.

4.Discuss about edge linking via Hough transform in detail.

5.Explain in detail about regional descriptors.

6. Write short notes on thresholding.

7.Discuss on Fourier descriptor.

UNIT IV

BASIC STEPS OF VIDEO PROCESSING

PART – A

1. What is analog video?

Analog video is a traditional method of recording video that uses continuous waves to store video information

2. What is digital video?

Digital video is audio/visual content in a binary format, with information is presented as a sequence of digital data rather than in a continuous signal.

3. What is 3-D motion model?

3D motion models are computer-generated objects that move through space, and can be used in advertising, marketing, and other media. 3D motion models are created using 3D modeling software, which allows users to manipulate points, lines, and polygons to create 3D shapes.

4. What is geometric image formation?

Geometric image formation is the process of determining where a point in a scene will be projected onto an image plane.

5. Write about photometric image formation.

Photometric image formation is the process of how light changes and is captured by a sensor to form an image in terms of color and pixel intensity.

6. What is sampling of video signals?

Sampling of video signals is the process of converting analog video signals into digital data for storage. This process involves taking samples of the video signal in three dimensions.

7. What is filtering operations?

Filtering is a neighborhood operation, in which the value of any given pixel in the output image is determined by applying some algorithm to the values of the pixels in the neighborhood of the corresponding input pixel.

8. Give the time-varying image formation models.

Three-Dimensional Motion Models, Geometric Image Formation, Photometric Image Formation

9. List applications of analog video.

Television broadcasting, Video surveillance and industrial control systems.

10. List applications of digital video.

Digital video is used in modern mobile phones and video conferencing systems.Digital video is used for Internet distribution of media, including streaming video and peer-to-peer movie distribution.

PART – B

1.Describe on analog video and digital video in detail.

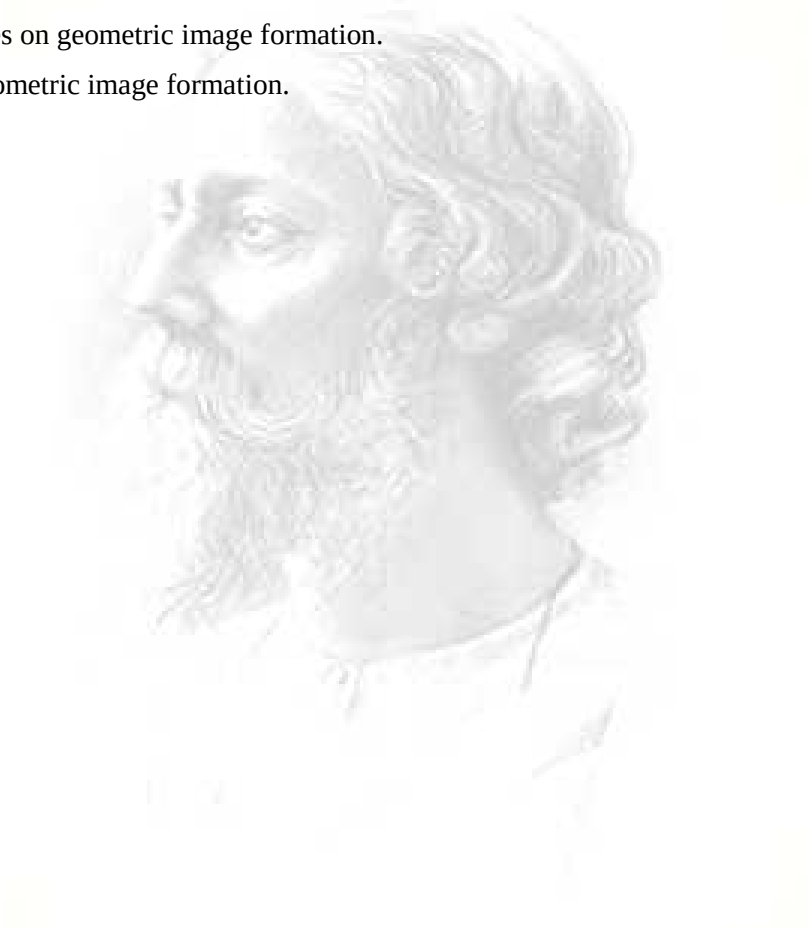
2.Discuss about time-varying image formation models.

3.Discuss about sampling of video signals in detail.

4.Explain in detail about filtering operations.

5. Write short notes on geometric image formation.

6.Discuss on photometric image formation.



UNIT V

2-D MOTION ESTIMATION

PART – A

1. What is optical flow?

Optical flow is a technique used to describe image motion. It is usually applied to a series of images that have a small time step between them, for example, video frames. Optical flow calculates a velocity for points within the images, and provides an estimation of where points could be in the next image sequence.

2. What is block matching algorithm?

A block matching algorithm is a way of locating matching macroblocks in a sequence of digital video frames for the purposes of motion estimation.

3. What are types of motion estimation techniques?

Pixel Based Motion Estimation

Mesh based Motion Estimation

Global Motion Estimation

Region based Motion Estimation & Multi resolution motion estimation

4. What is the need for motion estimation?

Motion estimation is a key technique in computer vision and other fields that helps to understand and analyze how objects move in images or video sequences.

5. What is predictive coding?

Predictive coding was originally proposed by Cutler in 1952. In this method, a number of previously coded pels are used to form a prediction of the current pel. The difference between the pel and its prediction forms the signal to be coded.

6. Define global motion estimation.

Global motion estimation (GME) is a technique that attempts to map one image onto another with a simple four-corner pin.

7. Define mesh based motion estimation.

Mesh-based motion estimation is a video processing technique that uses a mesh to estimate motion in a video. It's also known as warping or control grid interpolation.

8. What is optical flow constraints?

The optical flow constraint is an equation that expresses a constraint on the components of the optical flow vector, which is the apparent motion of brightness patterns in an image.

9. Define waveform based coding.

Waveform coding techniques describe the waveforms instantaneous behavior. This means that the waveform does not have to be speech; in fact it can be analog data or a signaling tone.

10. List the application of motion estimation in video coding.

Video compression: Motion estimation reduces the bit rate for motion parameters and prediction error signals. This helps improve video quality and optimize transmission.

Reducing redundancy: Motion estimation reduces the amount of redundant information stored.

Minimizing bandwidth usage: Motion estimation helps reduce the amount of bandwidth used.

PART – B

1.Brief about optical flow.

2.Explain on pixel based motion estimation in detail.

3.Explain in detail block matching algorithm with an example.

4.Describe on region based motion estimation.

5.Explain waveform based coding.

6.Write short note on predictive coding.

7.Explain the block based transform coding.

8.Explain about application of motion estimation in video coding.

9. Compare various motion estimation techniques.