Government Engineering College, Jhalawar

Department of Computer Science Engineering & Information Technology

Mid Term Paper – I

Subject: Digital Image Processing - VIII Sem Date: 15/02/2018

Q.1 Explain image sampling and quantization OR What do you mean a fourier transform? Explain its properties? (2.5)

Q.2 Write the categories of Image Enhancement and explain? (2)

Q.3 State the condition of transformation function s=T(r). (1)

Q.4 What do you think about wavelet transforms? How it is used in image processing? (2)

Q.5 Explain histogram equalization . Perform histogram specification on the following example :

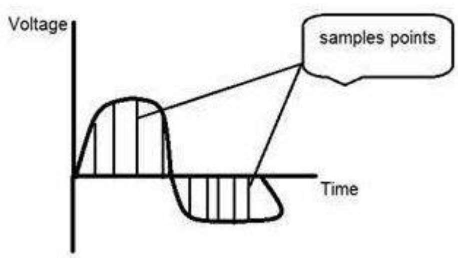
Gray level	0	1	2	3	4	5	6	7
Number of pixels	8	10	10	2	12	16	4	2

(2.5)

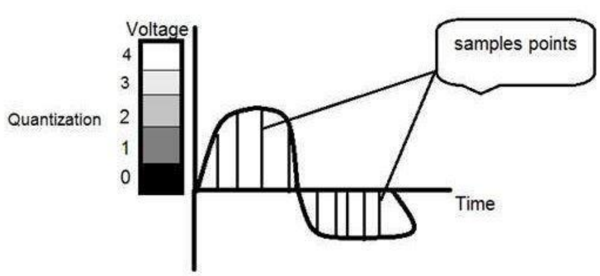
Ans 1. The output of most of the image sensors is an analog signal, and we can not apply digital processing on it because we can not store it. So we have to convert an analog signal into a digital signal. To create an image which is digital, we need to covert continuous data into digital form. There are two steps in which it is done.

- Sampling
- Quantization

The term sampling refers to take samples and digitize x axis in sampling It is done on independent variable. In case of equation y = sin(x), it is done on x variable



Quantization is done on y axis. It is actually dividing a signal into quanta (partitions).



The sampling rate determines the spatial resolution of the digitized image, while the quantization level determines the number of grey levels in the digitized image. A magnitude of the sampled image is expressed as a digital value in image processing. The transition between continuous values of the image function and its digital equivalent is called quantization. The number of quantization levels should be high enough for human perception of fine shading details in the image.

OR

Ans 1. The Fourier Transform is an important image processing tool which is used to decompose an image into its sine and cosine components. The output of the transformation represents the image in the *Fourier* or frequency domain, while the input image is the spatial domain equivalent. In the Fourier domain image, each point represents a particular frequency contained in the spatial domain image. For a square image of size N×N, the two-dimensional DFT is given by:

$$F(k,l) = \sum_{i=0}^{N-1} \sum_{j=0}^{N-1} f(i,j)\, e^{-\iota 2\pi \left(\frac{ki}{N} + \frac{lj}{N}\right)}$$

where *f(i,j)* is the image in the spatial domain and the exponential term is the basis function corresponding to each point *F(k,l)* in the Fourier space. The equation can be interpreted as: the value of each point *F(k,l)* is obtained by multiplying the spatial image with the corresponding base function and summing the result. In a similar way, the Fourier image can be re-transformed to the spatial domain. The inverse Fourier transform is given by:

$$f(a,b) = \frac{1}{N^2} \sum_{k=0}^{N-1} \sum_{l=0}^{N-1} F(k,l)\, e^{\iota 2\pi \left(\frac{ka}{N} + \frac{lb}{N}\right)}$$

Properties:

1) Separability
2) Translation
3) Periodicity
4) Conjugate Symmetry
5) Distributivity & Scaling
6) Convolution & Correlation

Ans 2. The categories of Image Enhancement are

1. Spatial domain
2. 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.

Ans 3. T(r) is single-valued and monotonically increasing in the interval 0 <= r <= L-1.

Ans 4. Wavelet transform : A wavelet is a mathematical function used to divide a given function or continuous-time signal into different scale components. Steps to compute CWT of given signal:

1. Take a wavelet and compare it to a section at the start of the original signal.
2. Calculate a number, C, that represents how closely correlated the wavelet is with this section of the signal.
3. Shift the wavelet to the right and repeat steps 1 and 2 until you've covered the whole signal.
4. Scale (stretch) the wavelet and repeat steps 1 through 3.
5. Repeat steps 1 through 4 for all scales.

It is widely used in Image Compression techniques.

Ans 5. Histogram equalization is a method in image processing of contrast adjustment using the image's histogram. This method usually increases the global contrast of many images, especially when the usable data of the image is represented by close contrast values. Through this adjustment, the intensities can be better distributed on the histogram. This allows for areas of lower local contrast to gain a higher contrast. Histogram equalization accomplishes this by effectively spreading out the most frequent intensity values.

Gray level r_k	No. of Pixels n_k	PDF $P_r(r_k)$	CDF	(L-1)*CDF	H_k
0	8	0.13	0.13	0.91	1
1	10	0.16	0.29	2.03	2
2	10	0.16	0.45	3.15	3
3	2	0.03	0.48	3.36	3
4	12	0.18	0.66	4.62	5
5	16	0.25	0.91	6.37	6
6	4	0.06	0.97	6.79	7
7	2	0.03	1.0	7	7