ASSIGNMENT-2

Q2.5. Figure 2.12 shows the digitization of an analog profile. What is the size of the resulting pixels? To what sampling frequency (in dpi) does this correspond?

Ans. The size of the resulting pixels is 1/20 cm. The sampling frequency (in dpi) is correspond to (20 samples/cm) * (2.54 cm/in) which is 50.8 dpi.

Q2.6. If a particular x-ray film has an optical density range of 4.2, how many bits should a digitizer have in order to quantize the gray levels, without loss of quality?

Ans. We need to find Io/It by taking the inverse log or anti-log of 4.2 because that is the optical density. The lowest increment is 1 and the highest is 15,849. We'll need 14 bits (2^(14) = 16,384) to count to this high.

Q2.7. High-definition television (HDTV) in the United States has adopted a standard of 1125 lines per frame (of which 1080 are active) and an aspect ratio of 16:9. If these images were captured as digital images, to what size of digital image (M × N) would they correspond? These images are transmitted 30 times a second; how much memory would be required to store a 2-hour HDTV program as a series of uncompressed images?

Ans.

N=1080

M = 1080(16/9) = 1920

The sum of these two values equals the amount of bytes required to store an image. If the images are transmitted at a rate of 30 frames per second,

(30times/sec) (60*60sec/hr)2hr = 60^ (3) images

= 60^ (3) (1080 . 1920)/1024

= 437400000 KB or 417 GB

To store the 2-HDTV program as a series of uncompressed images, we'll need roughly 417 GB; this implies we're watching in BW. Multiply the required RAM for RGB by 3 to get 1252 GB.

Q2.8. A laser beam, 100µm in diameter, is used to digitize a 35cm×42cm radiograph. If each pixel is to have dimensions comparable to that of the laser beam, of how many pixels is the digitized image composed?

Ans.

Across Breadth: 0.35/ (100 * 10^(-6)) = 3500 pixels

Along Length: 0.42/ (100 * 10^(-6)) = 4200 pixels

Total Number of pixels = 3500 * 4200 = 14700000 pixels = 14.0 Mpixels

Q2.9. The FWHM of the PSF of a certain CT imaging system is 2mm. How small should the pixels be? If the field of view (FoV) is 25cm, how many pixels are there along each side of the image?

Ans. The pixels should have an FWHM of around FWHM/3, i.e.

(2 x 10^(-3))/3 = 6.67 x 10^(-4) m

M pixels on one side = (24 * 10^(-2))/((20/3) * 10^(-4)) = 375 pixels.

Q2.10. Consider two different x-ray films: a fast film, A, comprising larger, coarser silver bromide crystals, and a slow film, B, with smaller, finer crystals. Why is film A faster, and what advantage does that confer? Which of the two films produces the sharper image?

Ans. Film A is faster because the photons are captured more efficiently by the larger, coarser silver bromide crystals, resulting in a darker image faster. With fewer X-rays, an image can be obtained, resulting in a lower dose to the patient. Because the size of the silver bromide crystals ultimately limits the spatial resolution, Film B produces a crisper image.