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Paper:- CR and DR

Q1:- Describe the features of preprocessing and postprocessing.

Features of Preprocessing the digital Radiographic Image:-

→ A principal advantage of digital radiographic imaging over screen-film radiographic imaging is the ability to manipulate the image before display — preprocessing — and after display — postprocessing.

→ Preprocessing of digital image is largely automatic.

→ Preprocessing actions are outlined in table 18-5.

Table 18-5	Digital Image Preprocessing
Problem	Solution
• Defective pixel	Interpolate adjacent pixel signals
Image lag	Offset correction
Line noise	Correct from dark reference zone.

→ Preprocessing is designed to produce artifact-free digital images.

→ In this regard, preprocessing provides electronic calibration to reduce pixel-to-pixel, row-to-row and column to column response differences.

→ Offset Images are automatic calibration images designed to make the response of the image receptor uniform.

→ Average techniques also are used to reduce the noise and improve contrast.

→ Gain images are generated every few months, and offset images are generated many

times each day - These preprocessing calibration techniques are identified as flat fielding.

Postprocessing the radiographic digital image :-

→ Postprocessing is where digital imaging shines. In contrast to preprocessing which is largely automatic, postprocessing requires intervention by the radiologic technologist and the radiologist

→ Postprocessing refers to anything that can be done to a digital radiographic image after it is acquired by the imaging system.

→ Post processing of digital images requires operator manipulation.

→ Post processing of the digital radiographic image is perform to optimize the appearence

of the image for the purpose of better detecting pathology.

→ Annotation is the process of adding text to an image.

→ By window and level adjustment, the radiologist can make all 65,536 shades of gray visible. This amplification of image contrast may be most important feature of digital radiographic imaging.

→ Subtraction of digital radiographic images obtained months apart temporal subtraction - is used to amplify changes in anatomy or disease.

→ The purpose of image subtraction is to enhance contrast.

→ Misregistration of subtraction image occurs when the patient moves during serial image acquisition. This can be corrected by re-registering the image through a technique called pixel shift.

More useful Function:-

Table 18-6 Digital Image Postprocessing

Process	Results
• Annotation	→ Label the image
• Window and Level	→ Expand the digital grayscale to visible.
• Magnification	→ Improve visualization and spatial resolution.
• Image Flip	→ Reorient image presentation
• Image inversion	→ Make white - black and black - white.
• Subtraction (DSA)	→ Improve Image Contrast.
• Pixel shift	→ Reregister an image to correct for patient motion
• Region of interest	→ Determine average pixel value for use in qualitative imaging.

Q2. Distinguish between spatial resolution and contrast resolution.

Spatial Resolution:-

→ Spatial resolution (resolution in space) is the ability of an imaging system to resolve and render on the image a small high-contrast object.

→ In medial imaging spatial resolution is described by the quantity "Spatial frequency".

→ Spatial frequency is expressed in line pair per millimeter (lp/mm)

→ A low spatial frequency represents large objects and high spatial frequency represents small objects.

→ As the spatial frequency becomes larger, the objects become smaller.

. Higher spatial frequency indicates better spatial resolution.

→ Large soft tissues such as liver, kidneys and brain have low spatial frequency and therefore are easy to image.
Such as breasts microcalcification and contrast filled vessels are high-frequency objects.

→ An imaging system with higher spatial frequency has better spatial resolution.

→ The spatial resolution of screen film radiography is determine by the geometry of the system, especially focal-spot size.

→ Mammography is best because of its small focal spot - 0.1mm for magnification

→ Spatial resolution in digital imaging is limited by pixel size.

Contrast Resolution:-

→ Contrast resolution is the ability to distinguish many shades of gray from black to white.

→ All digital imaging systems have better contrast resolution than screen film imaging.

→ The principal descriptor for contrast resolution is grayscale also called dynamic range.

Dynamic range:-

→ It is the number of gray shade that an imaging system can reproduce.

→ The dynamic range of digital imaging system is identified by the bit capacity of each pixel.

→ CT and MRI systems generally have 12-bit dynamic range ($2^{12} = 4096$ shades of gray).

→ DR may have a 14 dynamic range ($2^{14} = 16,384$ shades of gray).

Q3:- Discuss the characteristic of digital imaging that should result in lower patient radiation doses.

• Characteristics of a digital image:-

A digital image begins as an analog signal. Through computer data processing the image becomes digitized and is sampled many times. The critical characteristics of digital image are spatial resolution, contrast resolution nose, and dose efficiency of the receptor.

→ Perhaps the principal favourable characteristic of digital imaging is the opportunity of patient radiation dose reduction. This occurs because of the linear manner in which the image receptor responds to x-ray and because of the greater DQE of the digital image receptor.

Image Receptor Response:-

Because of the digital image receptor response is linearly related to radiation dose, image contrast does not change with dose. However poor technical factor selection may result in over exposure of the patient.

Contrast resolution is preserved in digital imaging regardless of dose.

Dose reduction with digital Radiography:-

→ Exposure should not be repeated in digital radiography (DR) because of contrast concerns.

→ DR System cannot compensate for excessive noised cause by quantum mottle.

→ Over exposed images do not have to be repeated and should not become a habit.

Q4- Discuss the features of an active matrix liquid crystal display.

Active matrix liquid crystal display (AMLCD)

→ A active matrix liquid crystal display is a type of flat panel display that uses cathode ray tube typically less than 4 inches. It is common used in mobile devices and televisions.
An active matrix include:-

- High refresh rates
- Polarizing sheets
- liquid crystal cells
- Thin film transistor (TFT)
  It has a higher quality picture, a faster response time as compare to other AMLCD also consume less power.

Q5:- Identify application of the picture archiving and communication system.

Application of the picture archiving and communication system:-

A picture archiving and communication systems (PACS) is a computerized means of replacing the roles of conventional radiological film as images are acquired stored transmitted and displayed digitally.

→ PACS aids in viewing storing communication and managing of medical digital images and related information.

→ The managing aspects facilities the work flows of an imaging department such as organizing study etc.

Features of PACS:-

→ Accelerated radiological workflows.
→ Save valuable time
→ Guide the workflow automatically preprocessing image etc.
The biggest advantage is huge increase in efficiency of data management.

Q6:- Discuss the three types of digital radiographic images artifacts and how to avoid them.

Ans:- An artifacts is an undesirable OD that appears on the screen film radiograph.

Artifacts occurs:-

(1) During the radiographic exposure
(2) During processing of the film
(3) When the films is being handled and stored before or after processing.

- **Exposure artifacts:-**
Exposure artifacts result of examination technique. These include patient motion, positioning errors, double exposure and improper grid positioning.
- **Processing artifacts:-**
It is often most pressure blemishes on the film emulsion caused by the roller transport system in the processor.
These includes, dirty roller, chemical fog, roller marks and wet pressure sensitization.
- **Handling and Storage artifacts:-**
The most bothersome handling and Storage artifacts are those associated with light or radiation fog, kink mark and static.

Q1. Describe the basis for data compression and difference between lossless and lossy compression.

- **Data compression:-**

Data compression is a method of lessoning the size of the data without the significant loss of information.

- **Difference b/w lossy compression and loseless compression:-**

Lossy compression and lossless compression are the two terms widely categorized under the data compression methods.

→ The major difference between lossy compression and loseless compression is that lossy compression produces a close match of the data after decompression whereas loseless compression creates exact original data.

Q8:- Identify difference b/w for processing images and for presentation Images.

As such when images are ready "for processing" for processing Images are manipulated into for presentation images that the radiologist can use for QC and for interpretation by the radiologist.

Before an image is prepared "for processing" several manipulation of the output of an Image receptor may be necessary to correct for potential artifacts.

Q9:- Explain how digital radiographic image artifacts occur . . . . alignment.

Ans.- Digital radiographic artifacts occur because of improper collimation, Partition and alignment is due to if the x-ray that Artifacts and Improper histogram analyzed Image not collimate and centered image image receptor exposure will not be accurate and cannot be used for image quality evaluation -
Alignment of exposure field orientation not aligned artifacts appears. The cause of collimation is vendor algorithm related. Thus the alignment with size and dimension of the IR, image artifacts can appear.