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Describe the Features of preprocessing and post processing?

Preprocessing

The principal advantage of digital radiographic imaging overscreen-Film radiographic imaging is the ability to manipulate the image before display - preprocessing - and after display - postprocessing.

* preimage processing and postimage processing alter image appearance usually for the purpose of improving image contrast.

* preprocessing of digital images is largely automatic.

* 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.

The processes of pixel interpolation lag correction, and noise correction are automatically applied with most systems.

Digital Image processing	
problem	Solution
Defective Pixel	Interpolate adjacent Pixel signals
Imge lag	offset correction
line noise	correct from dark reference zone.

- Offset images and gain Images are automatic calibration images designed to make the response of the image receptor uniform.
- Gain images are generated every few months, and offset images are generated many times each day. These preprocessing calibration techniques are identified as Flatfielding.
- Averaging techniques also are used to reduce noise and improve contrast.

Each type of digital image receptor generates an electronic latent image that may not be made visible completely.

What remains is image lag - and this can be troublesome when one is switching from high-dose to low-dose techniques, such as switching from digital subtraction angiography to fluoroscopy. The solution is application of an offset voltage before the next image is acquired.

* Some voltage variations may be seen along the buses that drive each pixel. This defect, called **Line noise**

Post processing

* 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.

* Postprocessing of digital images requires operator manipulation.

Postprocessing of the digital radiographic image is performed to optimize the appearance of the image for the purpose of better detecting pathology.

Digital Image postprocessing

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

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

* In addition to patient Identification is often helpful in informing the clinician about anatomy and diagnosis.

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

The larger matrix size display devices have better spatial resolution. because they have smaller pixels.

* At times; multiple digital images must be flipped horizontally or vertically. This process called image flip.

* 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 a 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.

* Greater use is being made of quantitative imaging, that is used of the numeric value of pixels to help in diagnosis.

* Edge enhancement is effective for fractures and small hig-contrast tissues.

a. Higlighting can be effective in identifying diffuse, non focal disease. Pan, scroll and zoom allows for careful visualization of precise regions of an image.

Q2. Distinguish between Spatial resolution and contrast resolution.

1) 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.

2) In medical imaging, spatial resolution is described by the quantity spatial frequency.

3) Spatial frequency is expressed in line pair per millimeter.

4) A low spatial frequency represent large, objects, and a high spatial frequency.

5) MTF is the ability of an imaging system to render objects of different sizes on image.

6) The modulation transfer function determines how much contrast in the

original object is maintained by the detector.

7) The ideal imaging system is one that produces an image that appears exactly as the object. Such a system would have an MTF equal to 1

Approximate spatial Resolution For various Medical Imaging Sytem.

Imaging System	Spatial Resolution
Gamma camera	0.1
Magnetic resonance Imaging	1.5
Computed tomography	1.5
Fluoroscopy	3
Digital Radiography	4
Computed radiography	6
Radiography	8
Mammography.	15
Diagnostic Ultrasound	2

Contrast Resolution

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

2) All digital imaging system have better contrast resolution than screen-Film imaging.

3) The principal descriptor for contrast resolution is grayscale, also called dynamic range

4) Dynamic range is the number of gray shades that an imaging system can reproduce.

5) The dynamic range of digital imaging systems is identified by the bit capacity of each pixel.

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

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

8) Because contrast resolution is so important in mammography such digital mammography systems have

a 16- bit dynamic range (2^{16} = 65,536 shades of gray)

Dynamic Ranges of Digital Medical Imaging system-

Imaging system	Bit Depth	shades of Gray
Diagnostic Ultrasonography	2^8	256
Nuclear Medicine	2^{10}	1024
computed resonance imaging	2^{12}	4096
Magnetic resonance imaging.	2^{12}	4096
Digital Radiography	2^{14}	16,384
Digital mammography	2^{16}	65,536

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

A digital image begin as an analog signal. Through computer data processing. the image become digitized and is sampled multiple times. The critical characteristics of a digital image are spatial resolution. contrast resolution - noise and dose efficiency (of the receptor) however to fully grasp how a digital image is formed and understanding of its basic component is necessary.

Pixel

A pixel or picture element is the smallest element in a digital image. If you have ever magnified a digital picture to the point that you see the image a small squares of colour you have seen pixels.

Pixel Size

The size of the pixel is directly related to the amount of spatial resolution or detail in the image. e.g Smaller the pixel, greater the detail.

Pixel Bit Depth

Each pixel contains pieces or bits of information. The number of bits within

a pixel is knows as pixel bit depth. Each pixel can have a gray level between 1 (2^0) and 65,536 (2^{16}) The gray level will be a factor in determining the image contrast resolution

Matrix

A matrix is a square arrangement of number in colums and rows, The image is digitized both by position (spatial location) and by intensity (gray level). The typical number of pixels in a matrix ranges from about 512 x 512 to 1024 x 1024.

Field of view

The term Field of view or FOV is synonymous with the x-ray Field. In other words it is the amount of body part or patient included in the image The large the FOV the more area is imaged.

Pixel Size, Matrix Size & FOV

A relation may exist between the size of the pixel, the size of matrix & to FOV The matrix size can be changed without affecting the FOV and the FOV can be changed without affecting the matrix size but a change in either the matrix size and to FOV change the size of the pixels

Dose Reduction with Digital Radiography

→ Exposure should not be repeated in digital radiography because of brightness or contrast concerns

→ DR systems cannot compensate for excessive noise, caused by quantum mottle.

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

Q4: Discuss the Features of an active matrix liquid crystal display?

An active-matrix liquid-crystal display (AMLCD) is a type of Flat-panel display the only viable technology for higher resolution TVs, computer, monitors, notebook computers tablet computers and smart phones with an LCD screen due to low weight, very good image quality wide color gamut and response time.

Light modulating, Flat face, Individual Pixel address, Pixel cross talk distortion square Pixel le nonuniformity.

Q5: Identify application of the picture archiving and communication system?
A picture archiving and communication system (PACS) is a te imaging technology

Radiology has adopted digital imaging very rapidly.

Estimates of the present level of digitally acquired images range up to 95%.

These digital images come from every area of medical imaging, including nuclear medicine, diagnostic ultrasound, ultrasonography, radiography, Fluoroscopy CT and MRI.

A picture archiving and communication system, when fully implemented, allows not only the acquisition but also the interpretation and storage of each medical image in digital form without resorting to film (hard copy). The projected efficiencies of time and cost are enormous.

PACS improves imag interpretation processing viewing, storage and recall.

Q6:- Discuss the three types of digital radiographic imaging artifacts and how to a avoid them?

A:- An Artifact is an False visual feature on a image that simulates tissue or obscres tissue.

Artifats interfere with diagnosis and must be avoided.

Similar to accidents, artifacts are, by definition Avoidable

Artifacts can be controlled when the cause of the artifact is understood.

Types of Artifacts

Image Receptor Artifacts

- Dust dirt, scratches
- pixel, malfunction
- Ghost images

Software Artifacts

- Histograms
- Range/scaling
- Image
- compression

Object Artifacts

→ patient positioning

→ collimator / partition

→ Back scatter.

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

A: The major difference between lossy compression and lossless compression is the lossy compression produces a close match of the data after decompression whereas lossless creates exact original data - Data compression is a method of lessening the size of the data without significant loss of information

Q. Identify the difference between For-processing images and For presentation images.?

Processing images

In electrical engineering and computer science, image processing is an form of processing for which the input is an image or a series of images or video, such as photographs or frames of video

The output of image processing can be either an image or a set of characteristics or parameters related to the image.

→ Image processing namely, analogue and digital image processing.

→ Image processing can be used for the hard copies like printouts and photographs.

Presentation Images

When creating a speech or a pitch to present to an audience, there's one element that you especially want to focus on to create an engagin experience - your presentation images. your presentation images allow you to showcase your story through visuals.

Q7. Explain how digital radiographic image artifacts occur because of improper collimation, partition or alignment?

Artifact and improper histogram analyzed - image not collimate dand centere images receptor exposure will not be accurate and cannot be used for image quality evaluation.

Partitioning

Allows two or more images. Multiple fields on single imaging plate. must have clear collimated edges and margin between each field.

→ partitioning of multiple digital images on a single IP results in proper seperation and collimation of each image.

Collimation

Cause of collimation artifacts vendor algorithm related.

exposure field recognition unable to mathc image histograms. if fields are not clear. algorithum based on edge detection or area detection

Alignment

Alignment of exposure field orientation not aligned artifact appears.