RADT-1351: IMAGE ACQUISITION AND EVALUATION

Cuyahoga Community College

Viewing: RADT-1351 : Image Acquisition and Evaluation

Board of Trustees:
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Academic Term:
Fall 2022

Subject Code
RADT - Radiography

Course Number:
1351

Title:
Image Acquisition and Evaluation

Catalog Description:
Analysis and application of radiographic factors influencing the acquisition and evaluation of the radiographic image. Students are required to conduct x-ray exposure experiments, under supervision, using standard energized imaging equipment.

Credit Hour(s):
3

Lecture Hour(s):
2

Lab Hour(s):
3

Requisites

Prerequisite and Corequisite
RADT-1300 Fundamentals of Ragiography, and departmental approval.

Outcomes

Course Outcome(s):
Safely operate radiographic equipment and ancillary devices to produce quality radiographic images.

Objective(s):

1. Develop exposure charts for various systems.
2. Describe the principal advantages and disadvantages of fixed and variable kVp systems.
3. Manipulate techniques for casts, pathologies, geriatric BMI, contrast medias.
4. State the steps necessary and considerations for proper use of AEC devices.
5. Explain the fundamentals of proper image receptor handling.
6. Demonstrate appropriate image identification and annotation.
7. Properly utilize ancillary devices such as grids, filters, and collimators, and apply correct technical manipulations to yield quality images.

Course Outcome(s):
Identify processes of image acquisition and display.

Objective(s):

1. Define brightness, gray scale, spatial resolution, and distortion as it relates to digital imaging.
2. Compare the differences between digital receptor components including: photostimulable phosphors, and amorphous silicon.
3. Compare DR image receptors including: flat panel detectors, charge coupled devices (CCD) and complimentary metal oxide semiconductors (CMOS).
4. Outline image processing steps from pre-processing through image display.

5. Evaluate digital imaging characteristics including pixel and matrix sizes.
6. Evaluate and compare spatial resolution and contrast resolution.

Course Outcome(s):

Establish a knowledge base of factors that govern the image production process.

Objective(s):

1. Describe latent image formation as it relates to computed radiography.
2. Describe how pathologic conditions will influence imaging techniques.
3. Demonstrate how scatter radiation adversely affects the digital image and provide methods to reduce scatter.
4. Describe various methods of assessing spatial resolution.
5. Develop a process for selecting optimal imaging ranges.
6. Discuss factors that influence exposure index values.
7. Define optimal kilovoltage and its effect on both the patient and the image.

Course Outcome(s):

Identify processes of post processing manipulations, archiving and retrieval.

Objective(s):

1. Evaluate gradation lines for digital imaging.
2. Describe the composition and function of each layer of a photostimulable phosphor plate (PSP).
3. Discuss display monitors, including viewing conditions and spatial resolution.
4. Extrapolate a range of acceptability for windowing and leveling in the digital image using the Agfa ADC.

Course Outcome(s):

Evaluate the hierarchy of imaging informatics.

Objective(s):

1. Differentiate between DICOM and PACS.
2. Differentiate between RIS and HIS.
3. Discuss EMR and EHR.

Course Outcome(s):

Use critical thinking skills to analyze images and resolve technical issues including those related to equipment, patient pathology, and digital post processing.

Essential Learning Outcome Mapping:

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):

1. Outline various imaging acquisition errors and their causes including histogram analysis errors, rescaling and dead pixel correction.
2. Extrapolate a technique chart from a limited number of phantom test images.
3. Analyze and compare hisotgrams of specific images.
4. Differentiate between different vendor-specific exposure indicator values.
5. Define and describe how to remedy quantum mottle and avoid exposure saturation.
6. Outline various image enhancement processess that may be used in digital.
7. Convert exposures based on radiographic rules using: the exposure maintenance law, the fifteen percent rule, the law of reciprocity, and grid usage.

Methods of Evaluation:

1. Homework assignments
2. Quizzes
3. Lab evaluation including critical thinking exercises
4. Tests
5. Presentation of all laboratory experiments
6. Final comprehensive exam

Course Content Outline:

1. Developing exposure charts
   a. System selection
   b. Manual exposure controls
   c. Anatomically programmed radiography
   d. Establishing a technique chart
   e. Fixed versus variable kVp
   f. Special considerations (casts, pathology, age, BMI, contrast media, grids, OID)
2. Automatic exposure control
   a. Detector selection
   b. Anatomy alignment
   c. Effects on quality
   d. Exposure adjustments (density, +1 or -1)
3. Digital imaging characteristics
   a. Spatial resolution
   b. Pixel characteristics (size, pitch)
   c. Detector element (DEL)
   d. Charged couple device (CCD)
   e. Complementary metal oxide semiconductors (CMOS)
   f. Sampling frequency (CR)
   g. Matrix size
   h. Modulation transfer function (MTF)
4. Contrast resolution
   a. Bit depth
   b. Detective quantum efficiency (DQE)
   c. Grids
5. Image signal
   a. Dynamic range
   b. Quantum noise (mottle)
   c. Signal to noise ratio (SNR)
6. Image identification
   a. methods (radiographic, electronic)
   b. legal considerations (patient data, examination data)
7. Criteria for Image Evaluation
   a. Exposure indicator
   b. Quantum noise (quantum mottle)
   c. Gross exposure error (loss of contrast, saturation)
   d. Contrast
   e. Spatial resolution
   f. Distortion (size, shape)
   g. Identification markers (anatomical side, patient, date)
   h. Image artifacts
   i. Radiation fog
8. Image receptors
   a. Computed radiography
      i. Plate (PSP)
      ii. plate reader
   b. Digital radiography
      i. Direct conversion
      ii. Indirect conversion
         1. Amorphous silicon (a-Si)
         2. charge coupled device (CCD)
         3. Complementary metal oxide semiconductor (CMOS)
   c. Beam restriction
9. Accessories
   a. Purpose and construction of the grid
   b. Grid patterns
   c. Grid uses

   d. Grid selection/conversions
   e. Bucky assembly
   f. Grid errors/Moire effect
   g. Compensating filters
10. Beam restrictors
   a. Effects of scatter
   b. Methods to limit scatter
   c. Differential absorption
   d. Filtration
11. Image processing and display
   a. Raw data (pre-processing)
      i. Analog to digital converter (ADC)
      ii. Quantization
      iii. Corrections (rescaling, flat-fielding, dead pixel correction)
      iv. Histograms
      v. Incorrect processing codes
   b. Corrected data for processing
      i. Grayscale
      ii. Edge enhancement
      iii. Equalization
      iv. Smoothing
   c. Data for display
      i. Values of interest (VOI)
      ii. Look up table (LUT)
   d. Post processing
      i. Brightness
      ii. Contrast
      iii. Region of interest (ROI)
      iv. Electronic cropping or masking
      v. Stitching
12. Display monitors
   a. Viewing conditions (angle, ambient lighting)
   b. Spatial resolution (pixel size, pixel pitch)
   c. Brightness and contrast
13. Imaging informatics
   a. Information systems (HIS, RIS, EMR, EHR)
   b. Networking
      i. PACS
      ii. DICOM
   c. Downtime procedures
14. Exposure conversion problems
   a. Solving complex exposure problems
   b. Calculating for distance
   c. Calculating for the fifteen percent rule

Resources

Carlton, R., and A. Adler. *Principles of Radiographic Imaging, An Art and A Science*. 6th. Clifton Park, NY: Thompson Delmar, 2020.

Carroll, Quinn B. *Radiography in the Digital Age* . 2nd ed. Springfield, IL: Charles C. Thomas, 2014.

Carroll, Quinn B. *Digital radiography in practice*. 1st ed. . Springfield, Il: Charles C. Thomas, 2019.

Carter, Christi and Veale, Beth . *Digital Radiography and PACS*. 3rd ed. St.Louis, Mo: Mosby Elsevier, 2019.

Fauber, Terri L. *Radiographic Imaging & Exposure*. 5th ed. St. Louis, MO: Elsevier Mosby, 2017.

Fosbinder, Robert A. and Densie Orth. *Essentials of Radiologic Science.* 2nd ed. New York: McGraw Hill, 2012.

Johnson, James, and Fauber, Terri. *Essentials of Radiographic Physics and Imaging.* St. Louis, MO; Mosby, 2012.

McQuillen Martensen, Kathleen. *Radiographic Image Anaylsis Workbook*. 5th ed. St. Louis, MO: Elsevier Saunders, 2020.

Seeram, Euclid. *Digital Radiography; An Introduction for Technologists.* Clifton Park, NY: Delmar Cengage Learning, 2011.

Resources Other

1. http://www.asrt.org (http://www.asrt.org/) American Society of Radiologic Technologists Radiography Curriculum
2. http://www.arrt.org (http://www.arrt.org/) American Registry of Radiologic Technologists Certification Handbook containing examination content specifications

Top of page
Key: 3845