R T 52D: DIGITAL IMAGE ACQUISITION & DISPLAY

Foothill College Course Outline of Record

Heading	Value
Units:	3
Hours:	3 lecture per week (36 total per quarter)
Prerequisite:	R T 55B.
Degree & Credit Status:	Degree-Applicable Credit Course
Foothill GE:	Non-GE
Transferable:	CSU
Grade Type:	Letter Grade Only
Repeatability:	Not Repeatable

Student Learning Outcomes

- Assess the application and components of a digital radiography system in order to maximize radiation protection of the patient in the clinical setting.
- Describe the components of both computed radiography and direct radiography equipment in conjunction with the process of image formation.

Description

Imparts an understanding of components, principles and operation of digital imaging systems found in diagnostic radiology. Factors that impact image acquisition, display, archiving and retrieval are discussed. Compare/contrast different types of digital systems. Principles of digital system quality assurance and maintenance. Intended for students in the Radiologic Technology Program; enrollment is limited to students accepted in the program.

Course Objectives

The student will be able to:
A. Differentiate between pixel size, matrix size, and bit depth.
B. Compare and contrast the computed radiography digital system with the direct radiography digital system.
C. Examine the potential impact the properties of digital radiographic systems have on patient exposure and methods of practicing the As Low As Reasonably Achievable (ALARA) concept with digital systems.
D. Categorize data acquisition and image extraction during the pre-processing phase for both CR and DR digital systems.
E. Describe the methods of post-processing in both a CR and DR digital system.
F. Evaluate various image acquisition errors and how they affect image quality.
G. Differentiate between quality assurance (QA) and quality control (QC).
H. Discuss the impact of viewing angle, luminance, ambient lighting, and pixel size on image display.
I. Describe picture archival and communications system (PACS) and its function.
J. Identify critical components of the DICOM header.
K. Relate HIPAA and patient confidentiality issues that arise with digital imaging and electronic records.

Course Content

A. Digital image characteristics
1. Picture elements - pixels
2. Pixel size
3. Matrix size
4. Spatial resolution
5. Bit depth
6. Information content - megabytes/image
B. Image acquisition
1. Detector types
a. Direct conversion and thin film transistor (TFT) arrays
1) Amorphous selenium
b. Indirect conversion and thin film transistor (TFT) arrays
1) Amorphous silicon
2) Scintillator
c. Charge-coupled device (CCD)
d. Complementary metal oxide semiconductor (CMOS) systems
e. Photostimulable phosphor (PSP) plate
1) Turbid phosphors
2) Columnar phosphors
C. Detector properties
1. Evaluation of detector characteristics
a. Detective quantum efficiency (DQE)
b. Modulation transfer function (MTF)
c. Spatial resolution
2. Dynamic range
3. Raw data extraction
a. Data extraction
1) TFT
2) PSP
3) CCD
b. Analog to digital conversion
c. Exposure field recognition
d. Region of interest (ROI)
e. Histogram analysis
f. Exposure index
4. Exposure indicators and deviation index
a. Air kerma (e.g. K indicator)
b. Deviation index (DI)
c. Exposure indicators
1) Centering and beam collimation
2) Optimal value ranges
D. Initial processing
1. Preprocessing
2. Image analysis
a. Segmentation
b. Exposure field recognition
c. Region of interest (ROI)
d. Histogram formation
e. Histogram analysis
3. Automatic rescaling
4. Values of interest (VOI)
5. Grayscale/look-up table (LUT)
6. Noise reduction
7. Smoothing
8. Edge enhancement
9. Equalization
E. Post processing
1. Brightness adjustment
2. Grayscale (contrast) adjustment
3. Equalization

4. Smoothing
5. Edge enhancement
6. Image reformatting
a. Electronic masking
b. Resizing
c. Rotation
F. Image acquisition errors
1. Histogram analysis
a. Incorrect anatomic menu selection
b. Exposure field recognition
1) Collimation border recognition
2) Exposure field distribution
a) Multiple fields/plate
c. Unexpected material in data set
1) Metal
a) Prosthetics
b) Plates and screws
2) Lead
d. Overexposure
e. Underexposure
f. Saturation
g. Failure of automatic rescaling
1) Dark image
2) Light image
2. Low intensity radiation response
a. Impact of accumulated background radiation
b. Image retention
1) Ghosting
3. Scatter control
a. Beam restriction
b. Grid use
1) Kilovoltage peak (kVp)
2) Grid cutoff
G. Quality management
1. Continuous quality improvement (CQI)
a. Standards for quality
b. Communications
c. Quality management manual
d. Responsibility and administration
e. Test equipment, procedures and training
f. Record-keeping
g. Test review
h. Evaluation
i. Continuing education
2. Quality assurance and maintenance issues
a. Technologist responsibilities
1) Image quality control
a) Exposure indicator accuracy
b) Image integrity
b. Imaging receptor systems
1) Receptor maintenance
a) Cleaning and inspection
b) Erasure
2) Equipment calibration
3) Uniformity
4) Spatial resolution
c. Reject analysis
d. Monitor patient exposure
1) Part of quality assurance (QA) program
2) Vendor-supplied software
e. Service engineer and/or medical physicist
1) Notification process
2) Preventive maintenance
f. Involvement in quality control
3. Benefits
a. Patient safety
b. Reduced radiation exposure
c. Efficacy of patient care
d. Departmental efficiency
e. Consistent image quality
f. Cost-effectiveness
H. Image display
1. Monitor
a. Characteristics
1) Aspect ratio
2) Spatial resolution
3) Brightness
4) Contrast ratio
5) Color vs. grayscale
6) Pixels
7) Active matrix array (e.g., AMOLED)
8) Nematic liquid crystals
9) Light polarization
10) Backlighting
b. Care and maintenance
c. Quality control
1) Grayscale standard display
a) SMPTE
b) AAPM
2) Luminance
3) Resolution
2. Viewing conditions
a. Ambient lighting
b. Viewing angle
3. Hard copy (e.g., laser film)
I. Data management
1. Network connectivity
2. Hospital/health information system (HIS)
3. Radiology information system (RIS)
4. Picture archiving and communication system (PACS)
a. System components and functions
b. Emergency contingency plan
J. Digital imaging and communication in medicine (DICOM)
1. DICOM header
a. DICOM metadata radiographer responsibilities
1) Access work order (worklist)
2) Postprocessing – image operation and manipulation
3) Annotation issues
4) Workflow
K. Privacy and confidentiality
1. Image transmission
2. HIPAA
3. Electronic medical record (EMR) or electronic health record (EHR)
4. Teleradiology

Lab Content

Not applicable.

Special Facilities and/or Equipment

A. Multimedia classroom
B. Digital radiology laboratory to create images for students to review
C. Digital QC equipment
D. Large flat panel monitor

E. Internet access

Method(s) of Evaluation

Methods of evaluation may include, but are not limited to:
A. Quizzes
B. Midterm
C. Comprehensive final exam
D. Participation in class discussion
E. Process reflection paper
F. Repeat analysis project

Method(s) of Instruction

Methods of instruction may include, but are not limited to: lecture, discussion, cooperative learning exercises, and demonstration.

Representative Text(s) and Other Materials

Fauber, Terri. Radiographic Imaging & Exposure. 5th ed. St. Louis, MO: C.V. Mosby, 2017. ISBN: 978-0-323-35624-4

Instructor: Course Syllabus

Types and/or Examples of Required Reading, Writing, and Outside of Class Assignments

A. Reading Assignments: Weekly 20 page reading assignments from text and outside white papers produced by the American Society of Radiologic Technology.

B. Reflection paper of a minimum of 3 pages comparing and contrasting digital imaging systems. This includes a requirement to interview a technologist to increase the student understanding of the radiographic equipment utilized by their assigned clinical affiliate.

Discipline(s)

Radiological Technology