DIGITAL RADIOGRAPHIC COURSE OUTLINE
40 Hour Course Length

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Chapter SUBJECT

1.0 Introduction
- 1.1 Digital Radiography Introduction
- 1.2 Digital Radiographic Comparison
- 1.3 Digital Radiographic Advantages and Disadvantages
- 1.4 Real-Time X-Ray
- 1.5 Digital Radiographic Personnel Qualification and Certification
- 1.6 Digital Imaging History Timeline
- 1.7 Industrial Digital Radiography Emergence
- 1.8 Digital Radiographic Definitions

2.0 Digital Imaging Properties
- 2.1 Digital Imaging Properties
- 2.2 Bits, Bytes and Bit Depth
- 2.3 Bit Depth and Dynamic Range
- 2.4 Creating a Digital File
- 2.5 Image Compression
- 2.6 DICONDE Concept
- 2.7 ASTM DICONDE Standards
- 2.8 Calculating the Size of a Digital File

3.0 Digital Imaging Equipment
- 3.1 Radiation Sources
- 3.2 Kinds of Radiation
- 3.3 Properties of Radiation
- 3.4 The Electromagnetic Spectrum
- 3.5 Radiation Machines
- 3.6 Linear Accelerator
- 3.7 Production of X-Rays
- 3.8 The X-Ray Tube
- 3.9 Types of X-Ray Tube Ports
- 3.10 Cooling
- 3.11 Focal Spot Size
- 3.12 Heel Effect
- 3.13 Effects of Kilovoltage
- 3.14 DR Considerations

3.15 Viewing Monitors
3.16 Display Monitor Resolution
3.17 Film Digitizers
3.18 Data Archival
3.19 The Origin and Explanation of RAID
3.20 CD Storage
3.21 Magnetic Tape
3.22 Cloud Storage
3.23 The Computer
3.24 The Computer Case
3.25 The Mother Board
3.26 The BIOS
3.27 The Computer Bus
3.28 Random Access Memory
3.29 Ports
3.30 Power Supply
3.31 Hard Drive
3.32 Computer Networks
3.33 Local Area Network
3.34 Wide Area Network
3.35 Peer to Peer Network
3.36 Server Based Network
3.37 Types of Computers
3.38 Network Connectivity
3.39 Network Interface Card

4.0 Digital Detector Arrays

4.1 Digital Detector Array Panels
4.2 Amorphous Silicon Flat Panels
4.3 Amorphous Selenium Flat Panels
4.4 CCD Digital Imaging Plates
4.5 CMOS Detectors
4.6 DDA Properties
4.7 Image Quality from a DDA
4.8 Signal and Noise
4.9 Spatial Resolution
4.10 Pixel Pitch
4.11 Basic Spatial Resolution (SRb)
4.12 SNR and Pixel Size
4.13 Efficiency
4.14 Detector Lag
4.15 Bad Pixel
4.16 Dead Pixel
4.17 Over Responding Pixel
4.18 Under Responding Pixel
4.19 Noisy Pixel
4.20 Non-Uniform Pixel
4.21 Persistence/Lag Pixel
4.22 Bad Neighborhood Pixel
4.23 Single Bad Pixel

4.24 Cluster of Bad Pixels
4.25 Cluster Kernel Pixel
4.26 Achievable Contrast Sensitivity (CSa) and Specific Material Thickness Range (SMTR)
4.27 Calibration and Gain/Offset Corrections
4.28 Pixel Binning
4.29 Bad Pixel Calibration
4.30 Pixel Binning
4.31 Radiation Damage

5.0 DDA Baseline and Process Controls
5.1 Digital Detector Array Baseline
5.2 System Spatial Resolution
5.3 Contrast Sensitivity
5.4 Material Thickness Range
5.5 Signal to Noise Ratio
5.6 Signal Level
5.7 Image Lag (Not for CMOS)
5.8 Burn-In (Not for CMOS)
5.9 Offset Level (Not for CMOS)
5.10 Bad Pixel Mapping
5.11 Display Monitor Checks
5.12 Luminous Intensity
5.13 Contrast Ratio
5.14 High Contrast Resolution
5.15 Flicker
5.16 Low Contrast Resolution
5.17 5% Contrast Blocks

6.0 Computed Radiography
6.1 Basic CR Process
6.2 Computed Radiography Imaging Plates
6.3 Phosphor Imaging Plate
6.4 Imaging Plate Classification
6.5 Photo Sstimulated Luminescence
6.6 History of Photo Stimulated Luminescence
6.7 The Reader
6.8 Processing the CR Latent Image
6.9 CR Processors
6.10 Processing and Digitization of PSL
6.11 Conversion to Look-Up Table
6.12 CR Latent Image Issues
6.13 Exposure Level and Image Quality
6.14 Dynamic Pixel Value Range
6.15 Image Plate Efficiency
6.16 Screens
6.17 Spatial Resolution
6.18 Balance of Contrast, Noise and Resolution
6.19 Field-of-View (FOV)
6.20 CR Artifacts
6.21 Artifacts from Atmospheric Conditions

6.22 Artifacts from Lead Screens
6.23 Artifacts from Impressions on IP's
6.24 Artifacts from Excessive Cleaning
6.25 Artifacts from Improper Handling
6.26 Artifacts from Electromagnetic Interference
6.27 Artifacts from Improper Eraser or Scanner Malfunction
6.28 Artifacts from Defective Imaging Plates
6.29 Artifacts from Software

7.0 CR Baseline and Process Controls
7.1 Computerized Radiographic Core Image Quality Tests
7.2 Contrast Sensitivity
7.3 Basic Spatial Resolution
7.4 Geometric Distortion
7.5 Laser Jitter
7.6 PMT Non-Linearity
7.7 Laser Beam Scan Line Integrity
7.8 Scan Column Dropout
7.9 Scanner Slippage
7.10 Shading
7.11 Banding
7.12 Erasure
7.13 Equivalent Penetrameter Sensitivity
7.14 Signal-to-Noise Ratio
7.15 Central Beam Alignment
7.16 Display Monitor Checks
7.17 Luminous Intensity
7.18 Contrast Ratio
7.19 High Contrast Resolution
7.20 Flicker
7.21 Low Contrast Resolution
7.22 5% Contrast Blocks

8.0 Image Enhancement
8.1 Window Leveling
8.2 Edge Enhancement
8.3 Sharpness
8.4 Image Addition
8.5 Image Subtraction
8.6 Image Division
8.7 Image Multiplication
8.8 Smoothing Filter
8.9 Median Filter
8.10 Unsharp Masking
8.11 Linear and Gaussian Filter
8.12 Image Magnification Measurement and Annotation
8.13 Background Removal or Shuttering
8.14 What Image Enhancement Cannot Do

9.0 Radiation Detection

- 9.1 Radiation Detection
- 9.2 Radiation Measurement
- 9.3 The Pocket Dosimeter
- 9.4 Film Badges
- 9.5 Thermoluminescent Dositmeters
- 9.6 Instadose Dosimeters
- 9.7 Optically Stimulated Luminescence Dosimeters
- 9.8 Survey Meters
- 9.9 Ionization Chamber Instruments
- 9.10 Geiger Counters
- 9.11 Alarm Rate Meter
- 9.12 Arizona Administrative Code

10.0 Nature and Consequences of Exposure

- 10.1 Radiation Health in Perspective
- 10.2 Measurement Units of Radiation Doses
- 10.3 The Nature of the Radiation Health Problem
- 10.4 Levels and Symptons of Radiation Injury
- 10.5 Common Terms of Reference for Gross Effects of Radiation Injury
- 10.6 Summary of Biological Effects of Radiation
- 10.7 Personnel Monitoring
- 10.8 Exposure fo the Total Population
- 10.9 Radiation Effects on Living Matter
- 10.10 Radio-Sensitivity
- 10.11 Type of Biological Effects of Radiation
- 10.12 Specific Effects of Radiation on Various Organs and Tissues of the Body
- 10.13 Effects of Radiation on the Lifespan
- 10.14 The Genetic Effects of Radiation

11.0 Geometric Principles

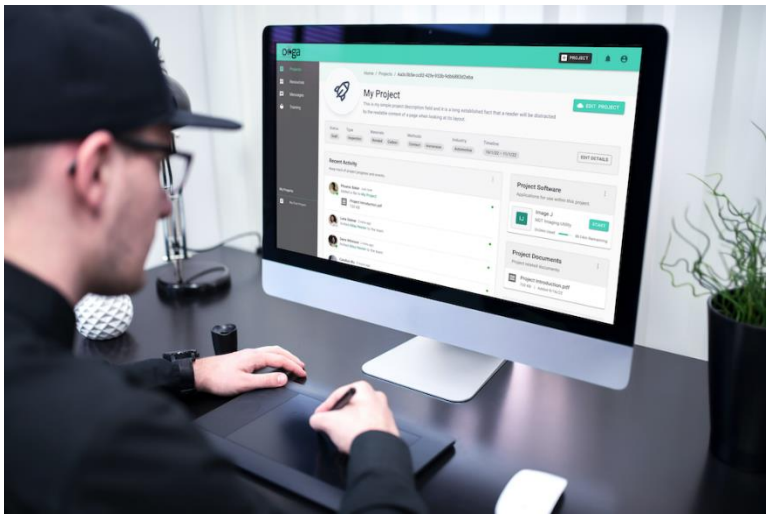
- 11.1 General Principles
- 11.2 Radiographic Shadows
- 11.3 Application to Radiography
- 11.4 Calculation of Geometric Unsharpness
- 11.5 Inverse Square Law
- 11.6 Half Value Layer
- 11.7 Penetrameters
- 11.8 Hole Type Penetrameters
- 11.9 Radiographically Similar Material
- 11.10 Wire Penetrameters
- 11.11 Comparison of Penetramter Design

12.0 Manufacturing and Discontinuities

- 12.1 General
- 12.2 Inherent Discontinuities
- 12.3 Processing Discontinuities
- 12.4 Service Discontinuities
- 12.5 Extrusions
- 12.6 Forgings

12.7 Castings
12.8 Weldments
12.9 Cracks

Hands-On Process Controls and Sample Part Inspections Included with Remote Softwares



Final Exam: 40 Questions Multiple Choice – 70% Passing

Sources:

TO 33B-1-2 Air Force NDI Manual
North Star Imaging Level 2 Digital Radiographic Course
XRI Level 2 Digital Radiographic Course
Carestream Level 2 Digital Radiographic Course
GE Inspection Technologies Level 3 Digital Radiographic Course
GE Inspection Technologies – Industrial Radiography Image Forming Techniques
Fuji Level 3 Digital Radiographic Course
Computed Radiography and Artifacts by S. Tyler Bouye
Digital Radiography and PACS, Third Edition, by Christi Carter and Beth Veale
ASTM E1647 - Standard Practice for Determining Contrast Sensitivity in Radiology
ASTM E2002 - Standard Practice for Determining Total Image Unsharpness and Basic Spatial Resolution in Radiography and Radioscopy
ASTM E2007 - Standard Guide for Computed Radiography
ASTM E2033 - Standard Practice for Computed Radiology (Photostimulable Luminescence Method)
ASTM E2445/E2445M - Standard Practice for Performance Evaluation and Long-Term Stability of Computed Radiography Systems
ASTM E2446 - Standard Practice for Classification of Computed Radiology Systems
ASTM E2597/E2597 - Standard Practice for Manufacturing Characterization of Digital Detector Arrays
ASTM E2698 Standard Practice for Radiological Examination Using Digital Detector Arrays
ASTM E2736 - Standard Guide for Digital Detector Array Radiology
ASTM E2737 - Standard Practice for Digital Detector Array Performance Evaluation and Long-Term Stability
ASTM E2738 - Standard Practice for Digital Imaging and Communication Nondestructive Evaluation (DICONDE) for Computed Radiography (CR) Test Methods