Advancements in Digital X-ray Detectors
Detector Overview

- Image Intensifier
- Amorphous Silicon Flat Panel
- CMOS Linear Array
- CMOS Flat Panel
- Linear Diode Arrays
- Computed Radiography
Image Intensifier

- Continue to improve overall performance.
- Better contrast sensitivity.
- Better special resolution.
- Significant improvements in camera technology have helped. High resolution at high frame rates.
Amorphous Silicon

- More scintillator options.
- More sizes.
- Higher frame rates.
- New interfaces electronics.
- Line scan options.
CMOS

- More sizes.
- More connection options.
- More pixel pitch options.
LDA

- LDA – Linear Diode Array
- More sizes.
- More pixel pitch options.
- More scintillator options.
- More connection options.
Computed Radiography

- Now in 5th generation.
- Double the resolution of previous generation.
- Improved imaging plates.
- Smaller Footprint.
- Enhancements to user interface.
Process Controls for Digital X-ray Detectors
History

- X-ray’s discovered late 1800’s.
- X-ray technology used for medical and industrial applications early 1900’s.
- ASNT formed 1940’s.

- What were standards and practices like 50 years ago?
Evolution

• Standards and standard practices evolve over time.
• Evolution through the study of the technology.
• Evolution through the reaction to a problem.
• Evolution through a change in technology.
Today

- Advent of digital detectors and the push to replace film is causing further evolution of standards and practices.
- Looking for ways to control the processes of digital imaging.
- The push is coming from the top down from major primes looking to increase quality and reduce cost.
Getting There

• Since this technology is computer based we can automate processes and eliminate human factor…

• Yes and no; we can automate some of the tests but we still need qualified personnel to interpret the results.
Getting There

- We need a guide to set the standards.
- Certain aspects can be automated to assist the technician.
- By automating the quality control checks we can produce quantifiable/repeatable data.
Quality Tools

• Common quality control tools include:
  – EN 462 Line Pair Gauge
  – Plaque type penny.
  – SMTPE test pattern.
  – Luminescence meter.
The IQI consists of 13 wire pairs embedded in rigid plastic.
The wires of platinum and tungsten are exactly spaced to correspond to the diameter of each pair.
The degree of unsharpness/resolution is indicated by the number of wire pairs that can be seen or measured.
Plaque Penetrameters

- Made of a shim of the same material to be inspected.
- It has a set of small holes to measure spatial resolution.
- The shim thickness $T$, is normally 2% of the test part thickness.
- The hole diameters are $1T$, $2T$ and $4T$.
- The sensitivity is said to be $2-2T$ when the $2T$ hole is visible in the $2\% T$ penetrameter.
- A penetrameter's resolution however does not necessarily directly relate to the size of a defect discernable in a given part.
SMPTE Pattern

- **SMPTE** - Society of Motion Picture and Television Engineers
- The performance of the display monitor is an important part of the imaging chain and therefore should be checked at regular intervals. The SMPTE 133 test pattern can be used to test the **Brightness and Contrast** performance as well as the **Spatial Resolution** (linearity) and for **Aliasing** (distortion).
Luminescence Meter

• Hand-held photometer for measuring luminance Intensity in candelas per meter squared (cd/m²).
Boeing Standard

Detector Qualification
- Bad Pixel Count and Mapping

Process Control Checks
- Detector Quality Check (monthly)
- Spatial Resolution Check (monthly)
- Contrast Sensitivity Check (monthly)
- Display Monitor Check (each shift & monthly)
Bad Pixel Mapping

- Divide the detector into a 100 x 100 pixel grid.
- Examine each cell of the grid and record location and number of bad pixels, bad pixel clusters (2,3 & 4+) and bad lines.
- Analyze the location of each defect in relation to each other to determine acceptable use.
Detector Quality Check

- Establish four 100 x 100 pixel ROI’s at the time of system qualification and record the coordinates of the ROI’s.
- Monthly; take statistics on the same four ROI’s established at qualification.
- Calculate the mean / std. deviation for all areas and results shall not deviate by more than 20%.
Spatial Resolution Check

- Monthly check.
- Acquire an image of the Duplex Wire Gauge.
- Examine the signal response for all line pairs in the gauge and determine which pairs produce a signal response of 30 – 90 percent.
- Use the results of this test to calculate system resolution.
Contrast Sensitivity Check

- Monthly check.
- Acquire an image of a plaque type penetrameter.
- Take statistics from an ROI of 0.2” x 0.2” on the IQI and immediately adjacent to the IQI.
- Use the results of this test to calculate the contrast sensitivity of the system.
- Verify that the contrast sensitivity has not deviated by more than 20%.
Display Monitor Check

• Six visual inspections of the SMPTE test pattern to be performed at the start of each shift.

• Measure monitor brightness and contrast every month.
Thank You