

Fluoroscopic Equipment Design: What's Different with Flat Panel?

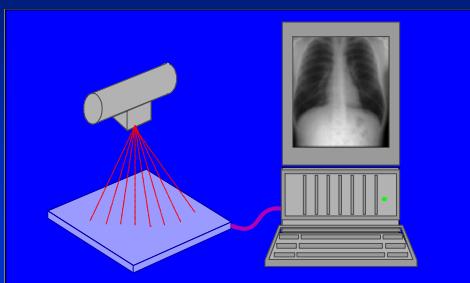
John Rowlands

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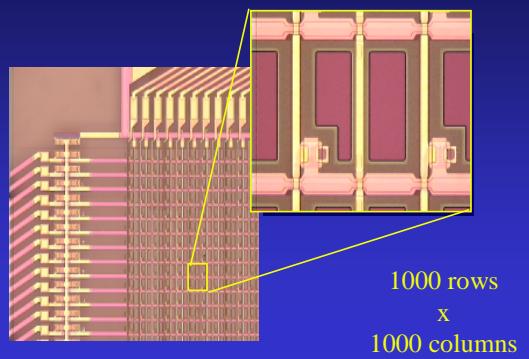
Financial disclosure statement

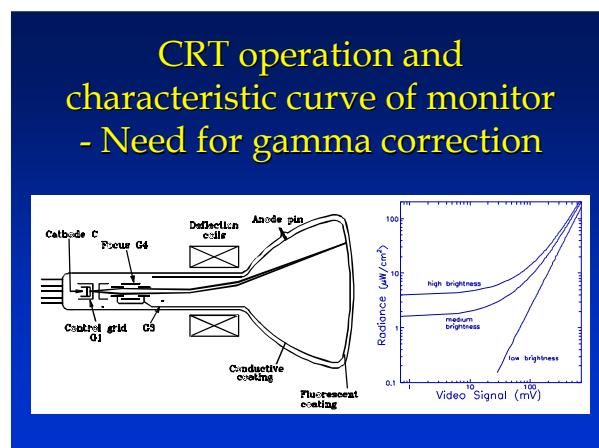
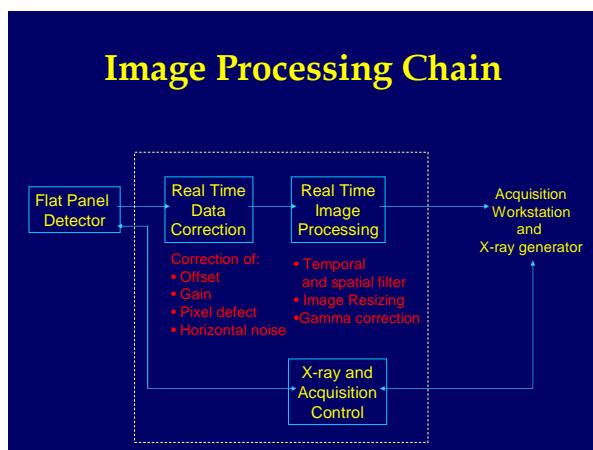
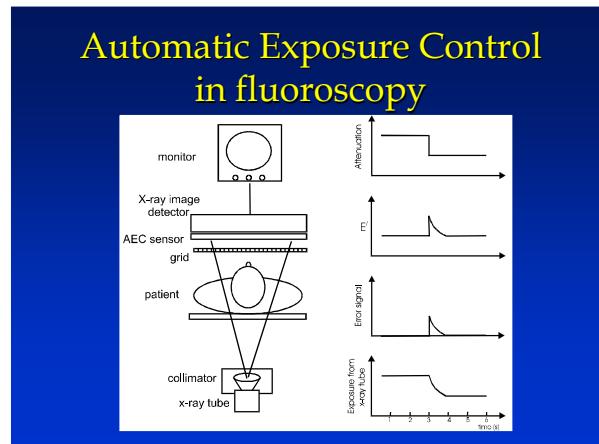
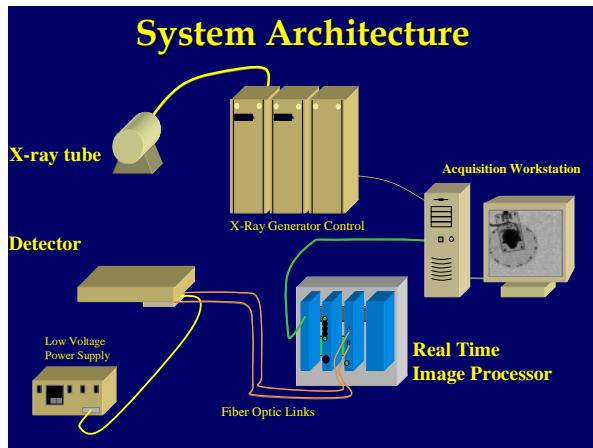
- Research supported by Anrad Corp
- Anrad Corp is a manufacturers of selenium based flat panel imagers

Concept of flat panel imager



Flat Panel Array Design





Offset and gain corrections

- Dark field – offset correction

Bright field – gain corrections

Enlarged
“bad”
region

As acquired image

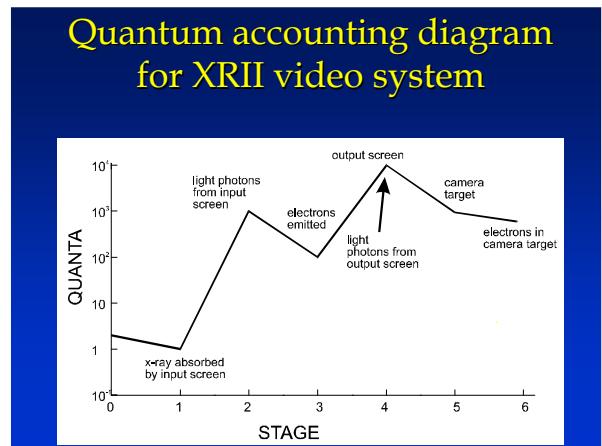
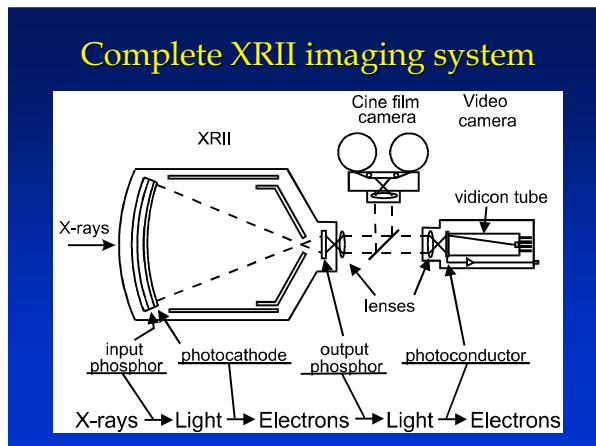
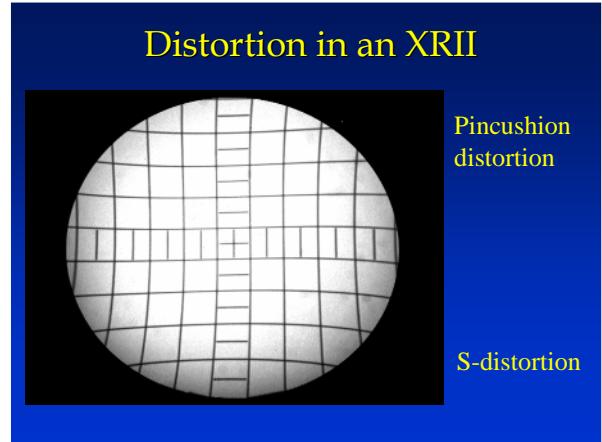
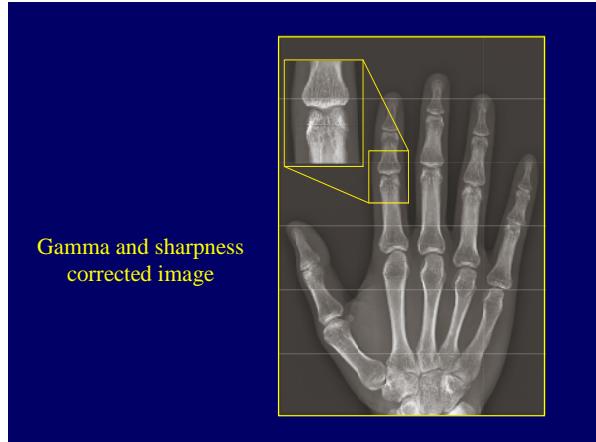


Gain and Offset
corrected with
Bright field and Dark
Field images
respectively

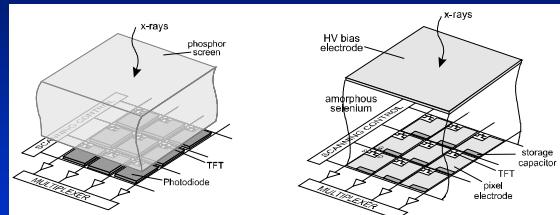


Bad lines and points
replaced by
interpolation





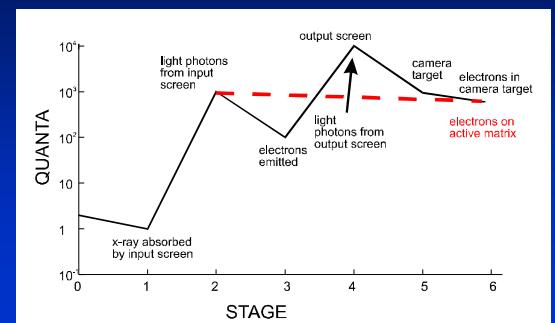
Flat panel detector types



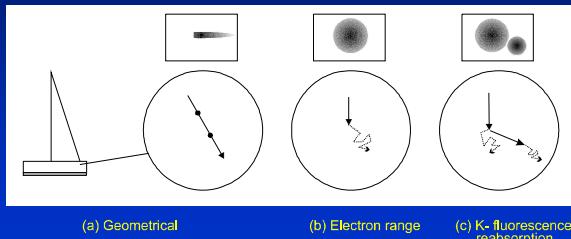
Indirect conversion
(CsI)

Direct conversion
(a-Se)

Quantum accounting diagram for flat panel system



Intrinsic sources of blurring in x-ray imaging systems

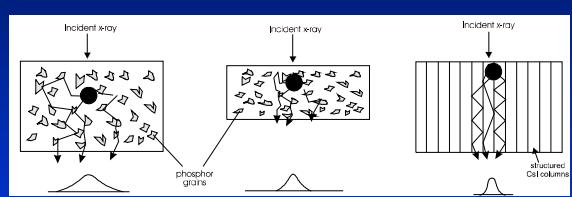


(a) Geometrical

(b) Electron range

(c) K-fluorescence
reabsorption

Phosphor blurring sources

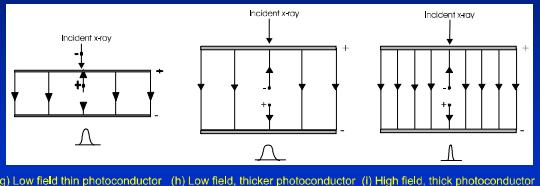


(d) Thick powder phosphor

(e) thin powder phosphor

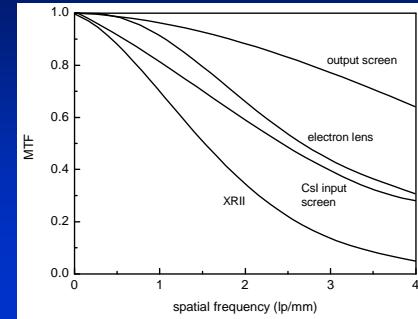
(f) Structured phosphor

Photoconductor blurring sources

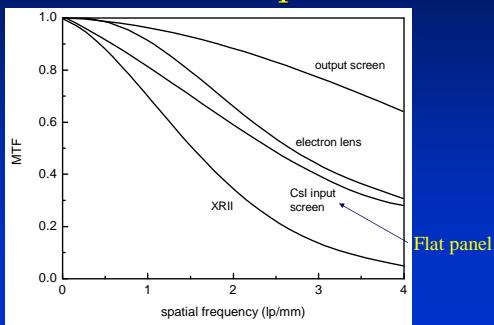


(g) Low field thin photoconductor (h) Low field, thicker photoconductor (i) High field, thick photoconductor

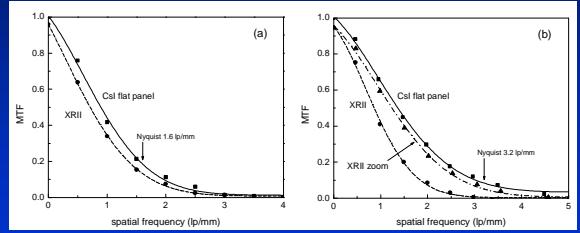
Components of MTF in an XRII



Components of MTF in an XRII and flat panel



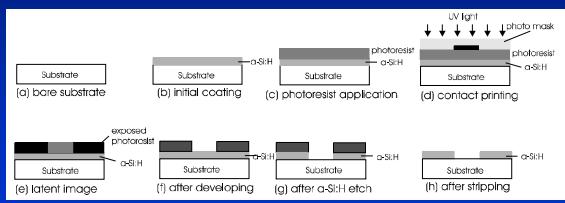
MTF of XRII and flat panel



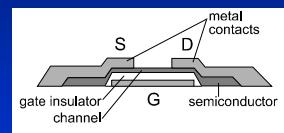
Normal mode

Zoomed mode

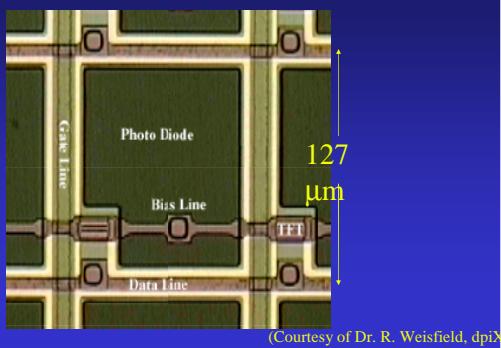
Principle of photolithography



Thin film transistor or TFT

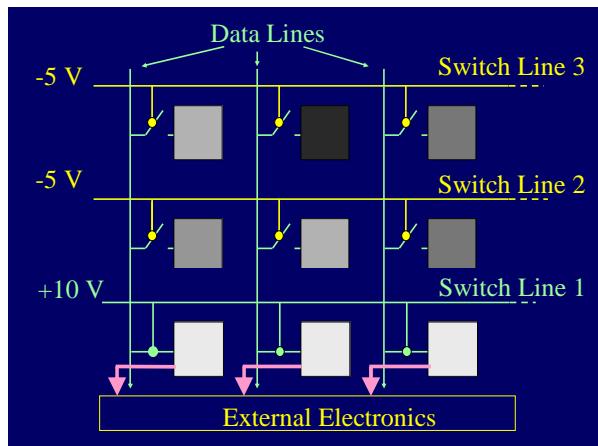
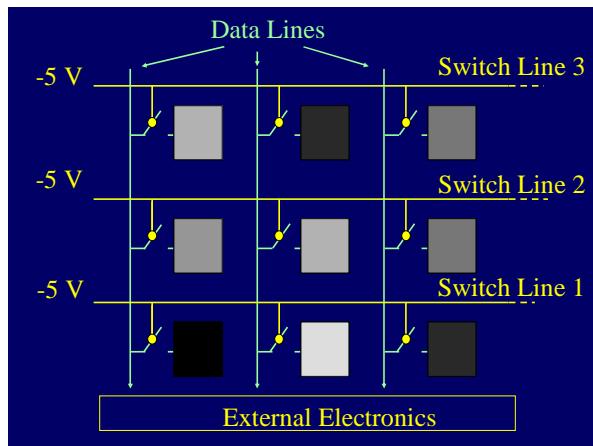
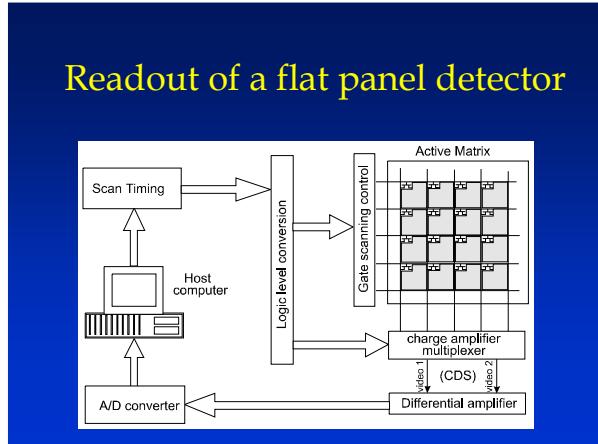
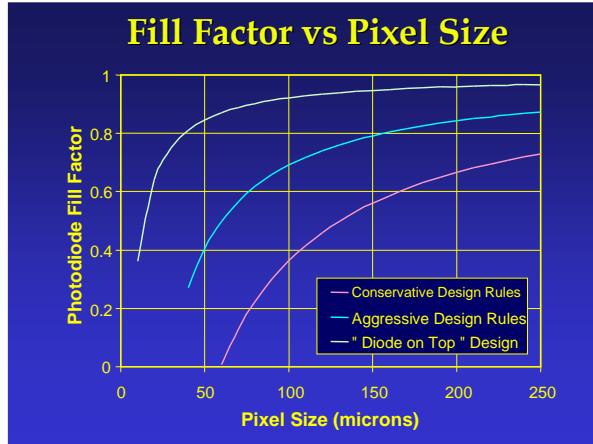


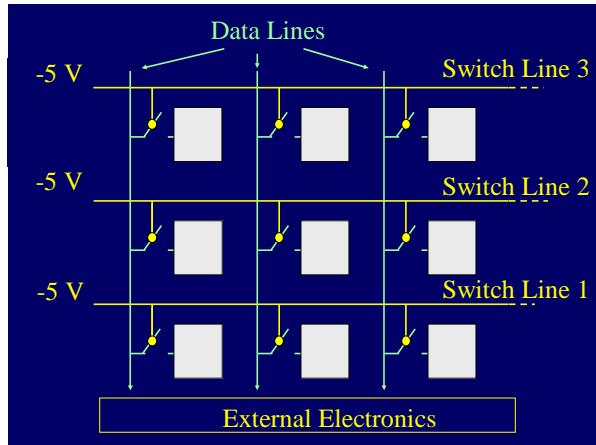
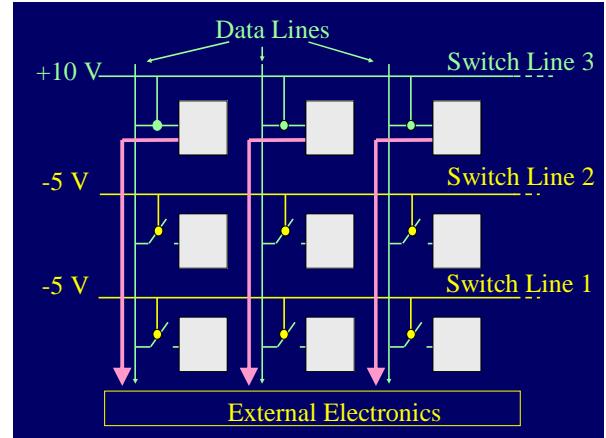
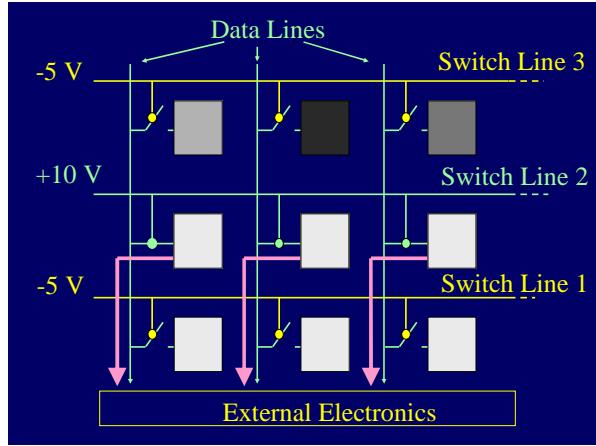
TFT+Photodiode Pixel Design



Array Design Rules

- Distance between neighboring features
- Width of control lines
- Thickness of different layers





Artifacts arising from inadequate corrections

- Regions of different intensity
- Blurring
- Line correlated noise

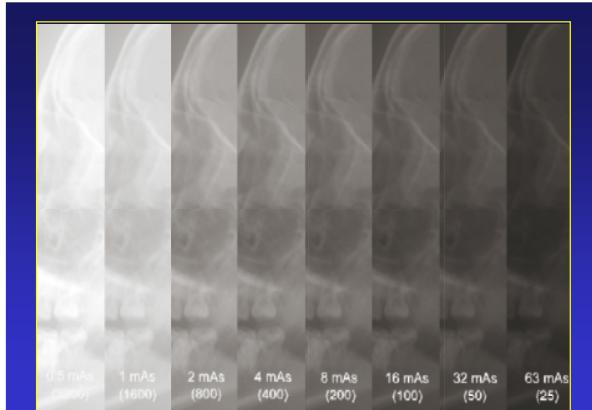


Image Courtesy of Dr. U Neitzel, Philips

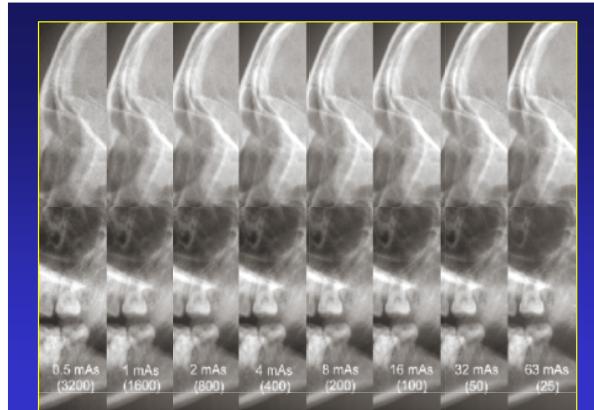
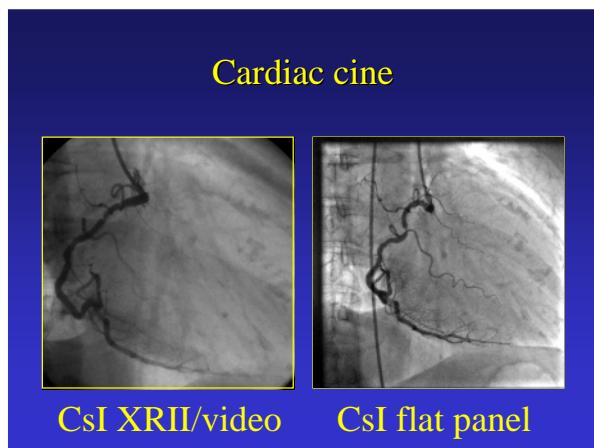
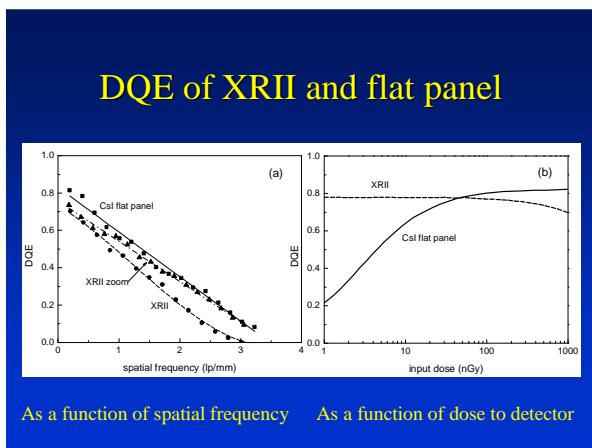


Image Courtesy of Dr. U Neitzel, Philips



Advantages of flat panel imagers

- High dynamic range
- Corrections for monitor non linearity
- Compact form factor
- Suitability for advanced applications

Future developments

- Not yet quantum noise limited at low exposures
 - Amplifier per pixel
 - High conversion efficiency photoconductor
 - Avalanche gain
- System on glass