Diagnostic Imaging Tour!
Welcome!

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Objectives

• Introduction to concepts in imaging concepts from software design
• Introduce the vendors
Contrast

\[ C_s = \frac{A - B}{B} \]
Resolution

- Line pairs per distance
- Express limiting resolution
- Limiting resolution implies high contrast situation
- Does not indicate how well system preserves contrast

4 lines (line pairs) per mm
Resolution
Modulated Transfer Function (MTF)
Skin entrance dose doesn’t depend on focal spot size.

**Interventional fluoroscopy**

**Fluoroscopic x-ray system**

**Anti-scatter Grid**
- blocks scattered x-ray
- increases radiation dose

**Collimated x-ray beam**
- controls dimension of x-ray

**Automatic Exposure Rate Control (AERC)**
- Image quality, dose rate, and dose control feedback circuits

**Flat panel image receptor**
- converts transmitted x-ray pattern to digital image

**Separator cone**
- maintains minimum distance from patient

**X-ray tube**
- x-ray beam fans out from point about 1 mm in size
TLD BADGE

CROCODILE CLIP

METALLIC FILTER

SEALED POLYTHENE POUCH

TRANSPARENT PLASTIC

PERSONNEL NUMBER

NAME

RADIATION TYPE

PERIOD OF USE

NCRP 116, occupation equivalent dose limit 0.5 Sv
CTDvol

(a) Polyethylene: ~93 HU  
(b) "Bone": ~955 HU  
(c) Water: ~0 HU  
(d) Acrylic: +120 HU  
(e) Air: -1000 HU

CTDvol: approximate dose to a “slab” of patient, estimated from a measurement made on a phantom.

DLP: CTDvol x total length of the scan. This is expressed in mGy*cm.
Contrast: Hounsfield Unit
\[ S(t) = e^{-t/T_{2s}} \]
\[ S(t) = e^{-t/T_{2m}} \]
\[ S(t) = e^{-t/T_{2l}} \]
"T₁ Relaxation"

"Repetition Time (TR)"

\[ M(t) = M_{0s}(1 - e^{-t/T_{1s}}) \]

\[ M(t) = M_{0m}(1 - e^{-t/T_{1m}}) \]

\[ M(t) = M_{0l}(1 - e^{-t/T_{1l}}) \]

"T₁-Weighted Image"
Bone (1 ms)
Lungs (0.1-2 ms)
Liver (40 ms)
Muscle (45 ms)
White Matter (90 ms)
Gray Matter (100 ms)
CSF (160 ms)
Water (1000 ms)

Repetition Time (TR)

\(\sim T_1\)
\(\gg T_1\)

Echo Time (TE)

\(<T_2\)
\(T_2\)

\(<< T_2\)

\(T_1\)

\(M_0\)
Ultrasound Pulse Interactions

- **Absorption**: BAD
- **Reflection**: GOOD and BAD
- **Refraction**: BAD
Ultrasound Pulse Reflection

Reflection formula:
\[
\text{Reflection} = \left( \frac{Z_2 - Z_1}{Z_2 + Z_1} \right)^2
\]

Impedance formula:
\[
\text{Impedance (Z)} = \text{Density} \times \text{Velocity}
\]

Tissue - 1.63
Air - 0.0004

Reflection:
\[
\text{Reflection} = +99.9\%
\]

Air is a strong reflector.
MRGRT MOTION MANAGEMENT QA PHANTOM
MODEL 008Z
Trusted Accuracy
Better care starts with accuracy

For 20 years, Modus QA has been at the forefront of quality assurance in the field of advanced radiotherapy and medical imaging. We have earned the trust of the world's leading medical physicists by creating phantoms and software that help them fulfill their responsibilities with the utmost confidence. Founded in science and committed to collaboration, as treatment and imaging options continue to evolve, we continue to innovate – enabling accuracy when it matters most.
Enjoy the tour!

Christiane Sarah Burton