

Lecture 16: Medical Imaging

(Quiz)

0. Review

1. Intro

2. Radiography

3. CT

4. MRI

5. Ultrasound

This
week:

Lab practical
(see website)

Exam #2 Thu (Mar 5)
→ Course website has
PreLab, QZ, HW solns,
2019 exam + solns

Lab 6
Report
due Fri
(Mar 6)

Next
week:

Student
presentations
(Mar 10 + 12)

Ellis Tour (Mar 10)
Group 1 (12:45 - 2:30)
2 (2:45 - 4:30)

↑
Meet in ISEC 150

Ethics paper
due Fri
(Mar 13)

- ↑
- See FDA website for database
 - Email topic to Bumca

0. Review

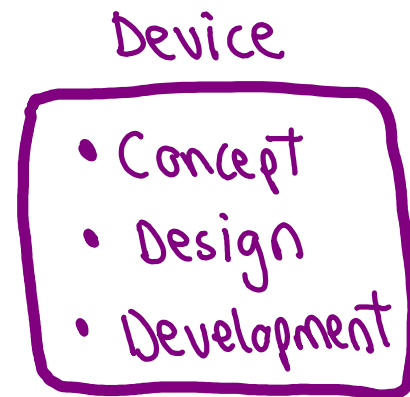
(16.0)

1976: Medical Device Amendments (MDA)
→ premarket requirements

"substantial equivalence"

510(k)

Premarket

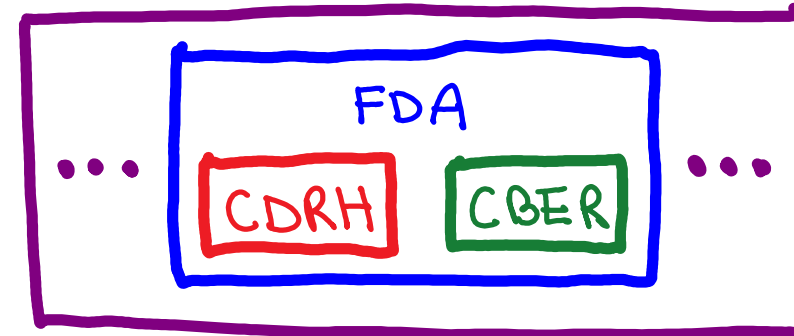


1: Low risk
2: Med risk
3: High risk

PMA

"Safe + Effective"

DHHS

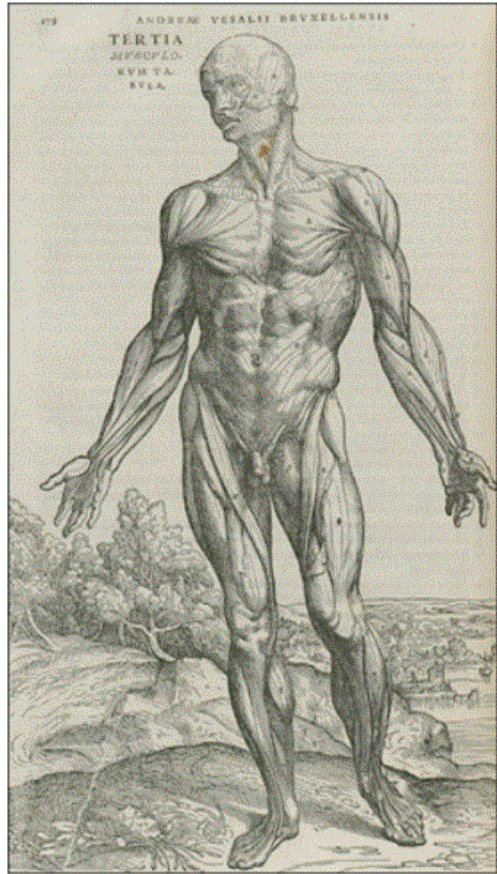


Postmarket

- Manufacturing
- Labelling
- Surveillance
- Device tracking
- Adverse Event Reporting

1. Intro

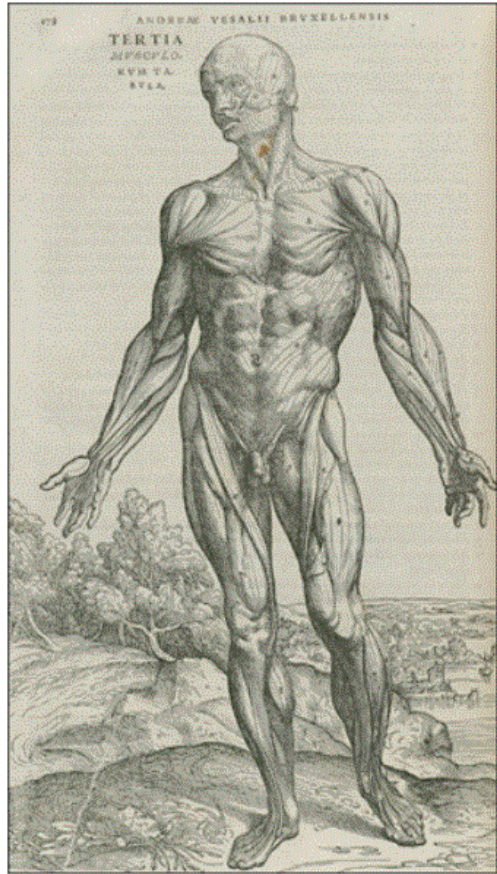
Medical Illustration



www.nlm.nih.gov/exhibition/dreamanatomy/da-gallery.html

1. Intro

(1543)
Medical Illustration



(1895)
1st X-ray image

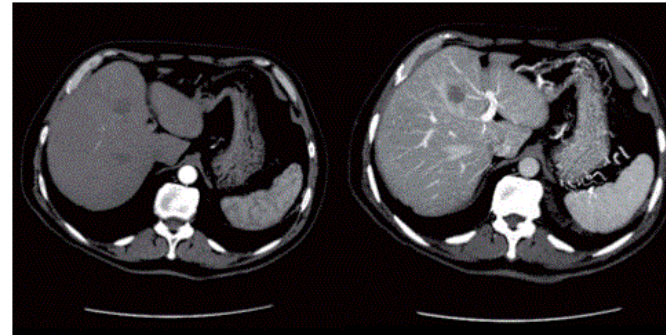


VS.

Today...

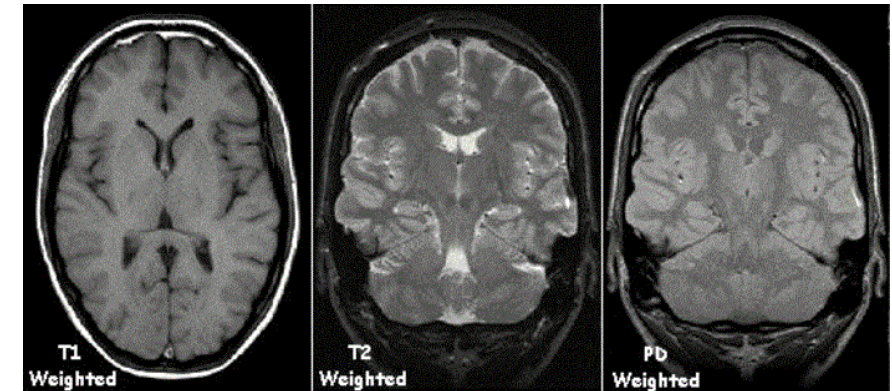
CT

(GE)



MRI

(wikipedia)



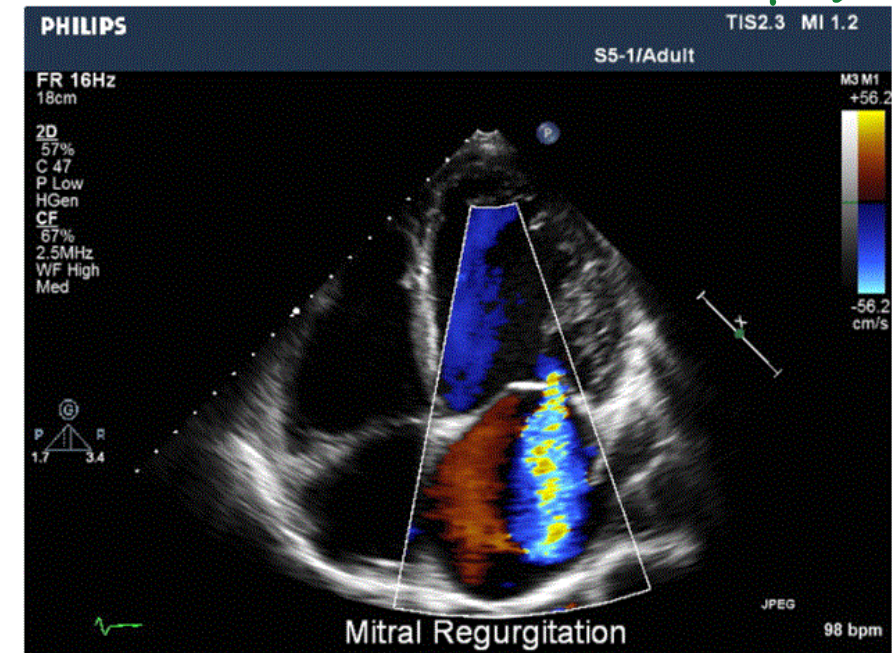
Multi-slice CT



(Siemens)

ultrasound

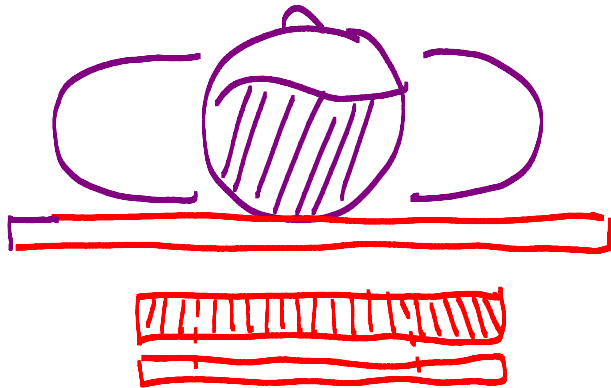
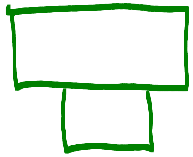
(philips)



www.nlm.nih.gov/exhibition/dreamanatomy/da_gallery.html

2. Radiography

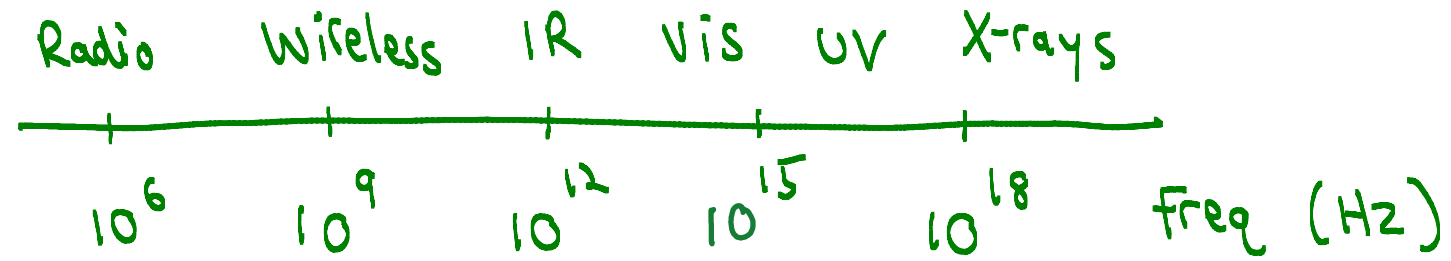
A. Basic geometry



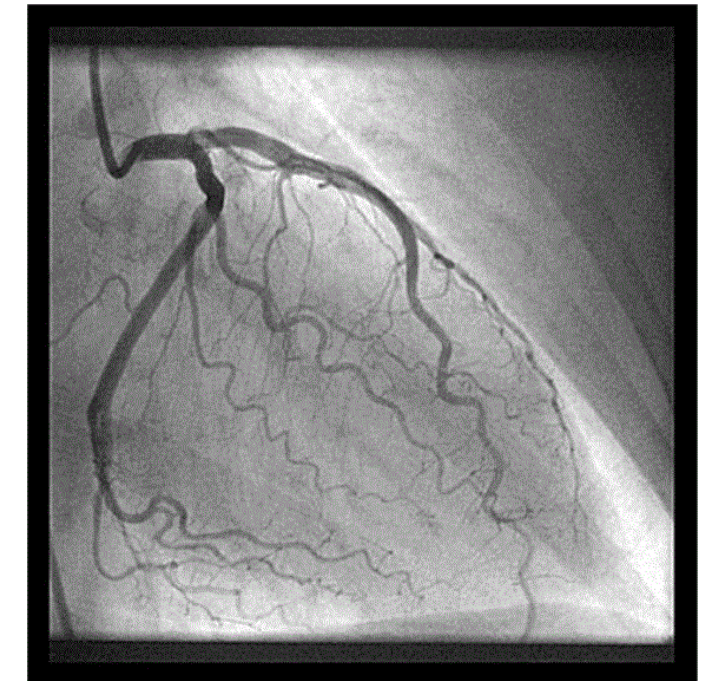
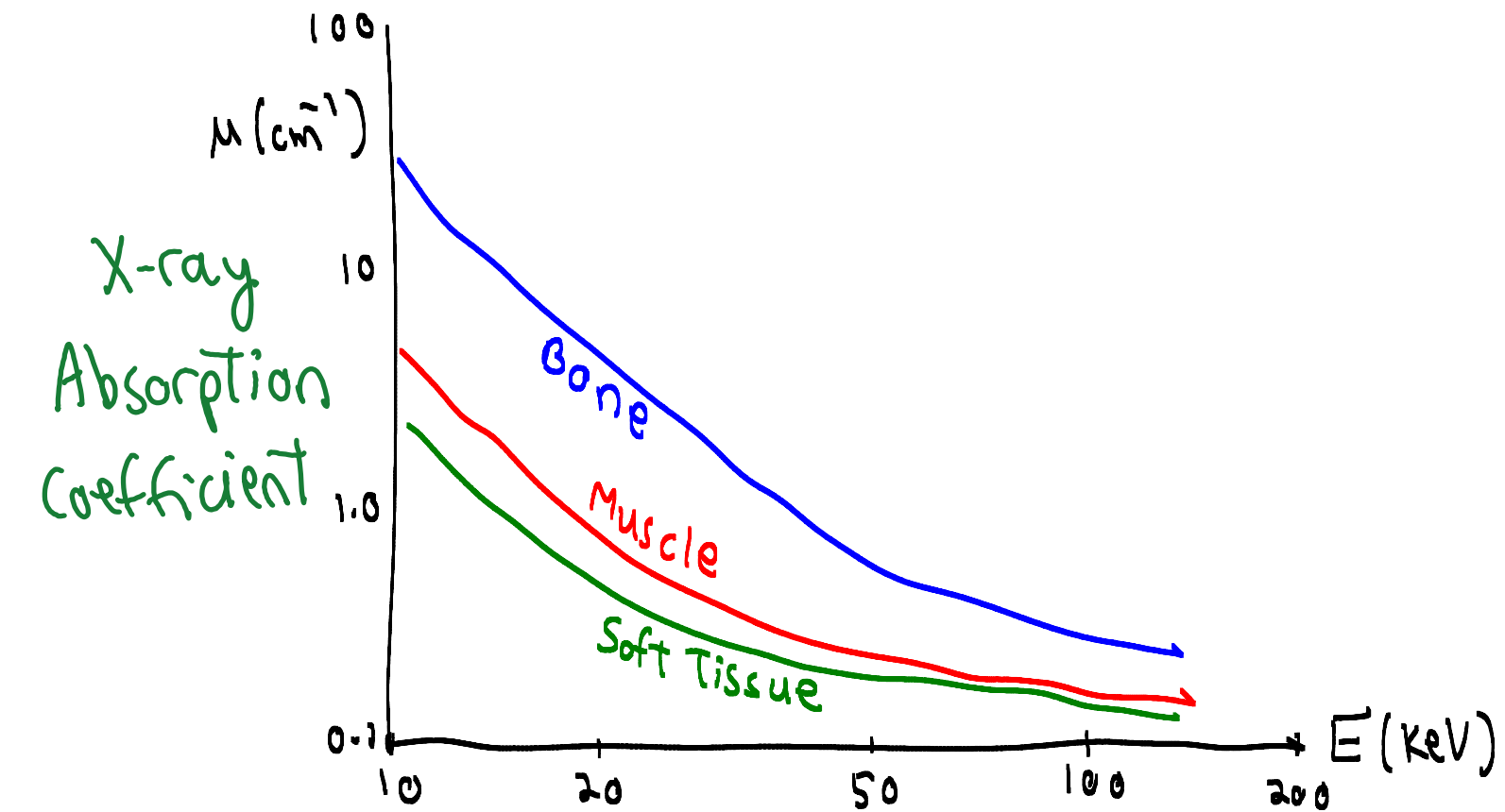
(16.2)

• X-rays: Electromagnetic Spectrum

(16.3)

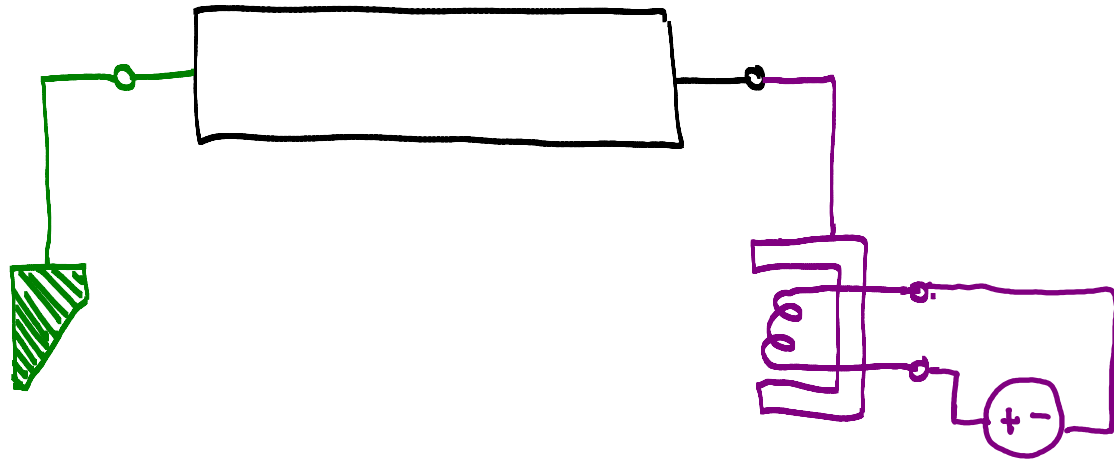


- Soft X-rays
- Hard X-rays



C. X-ray Source

- X-rays are produced when electrons slam into the tungsten anode



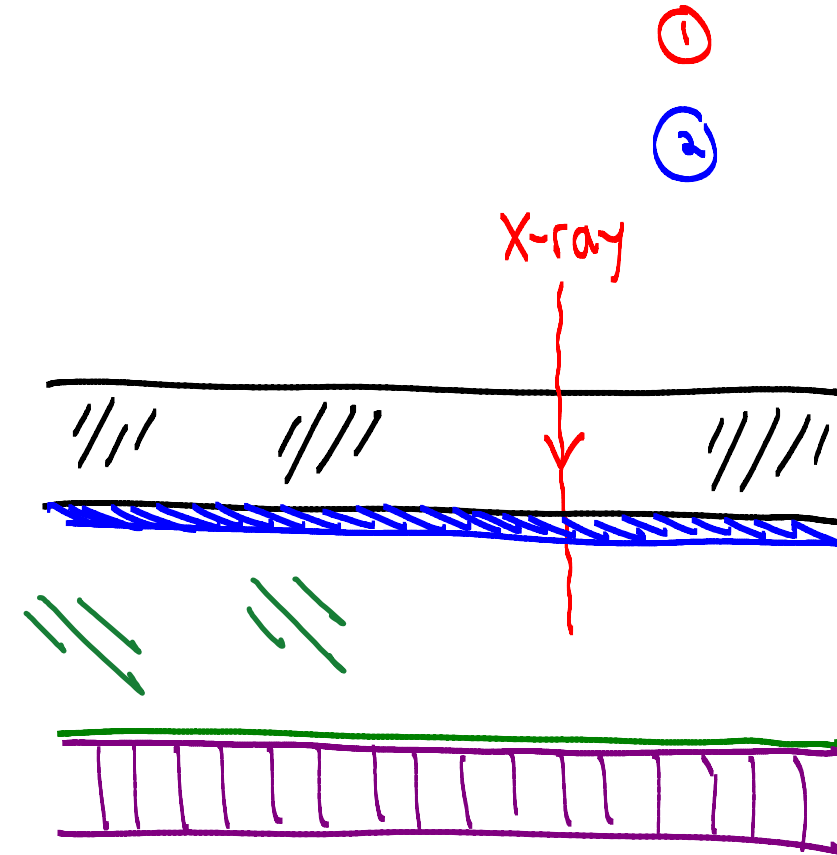
- User selectable parameters

①

②

③

D. X-ray Detectors ← Two step process:



General Radiology



Canon

Dental X-rays

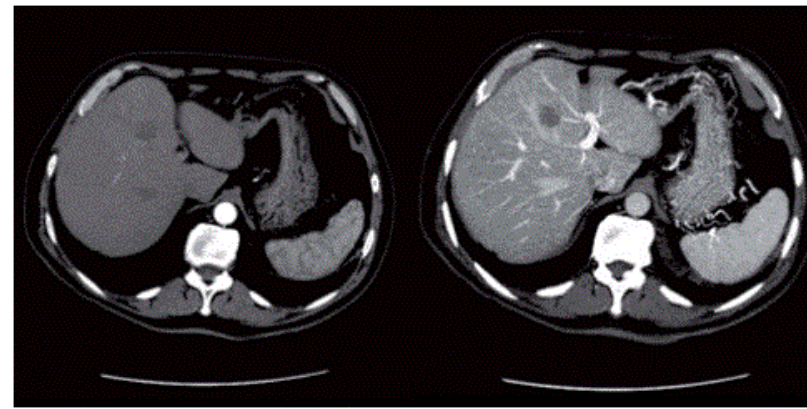
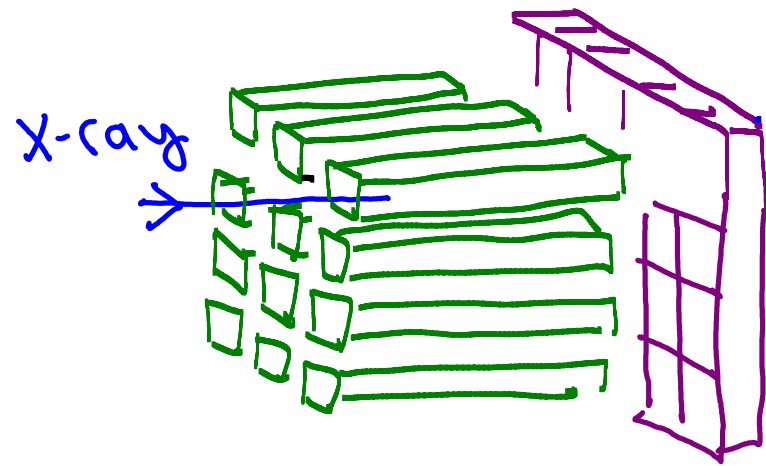


Detector array! ↗

atlantic avemedental

3. Computed Tomography (CT)

- Unlike projection radiography, computed tomography produces cross-sectional images
- CT Detector Arrays:

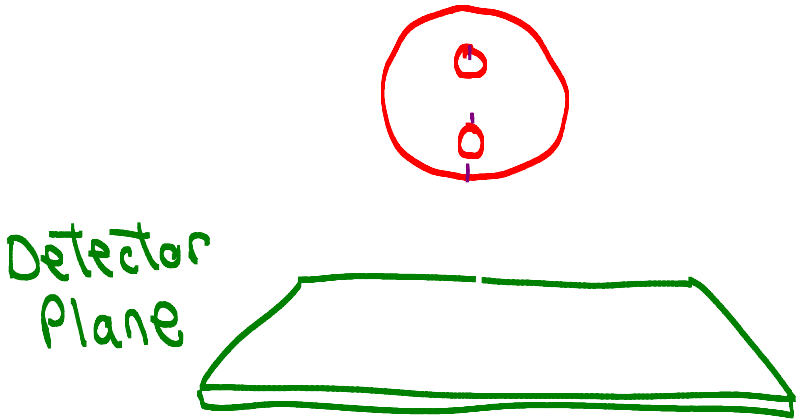


• Gantry

• Patient Table

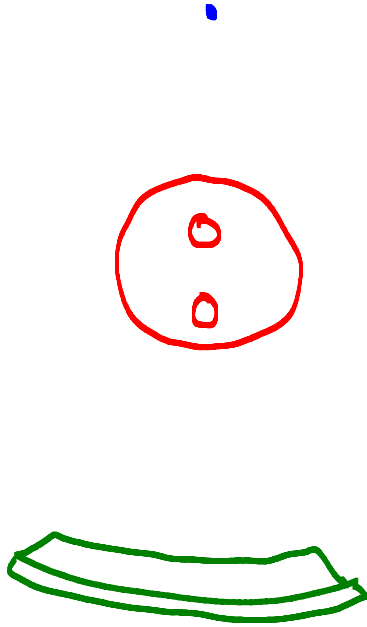
Projection Radiography

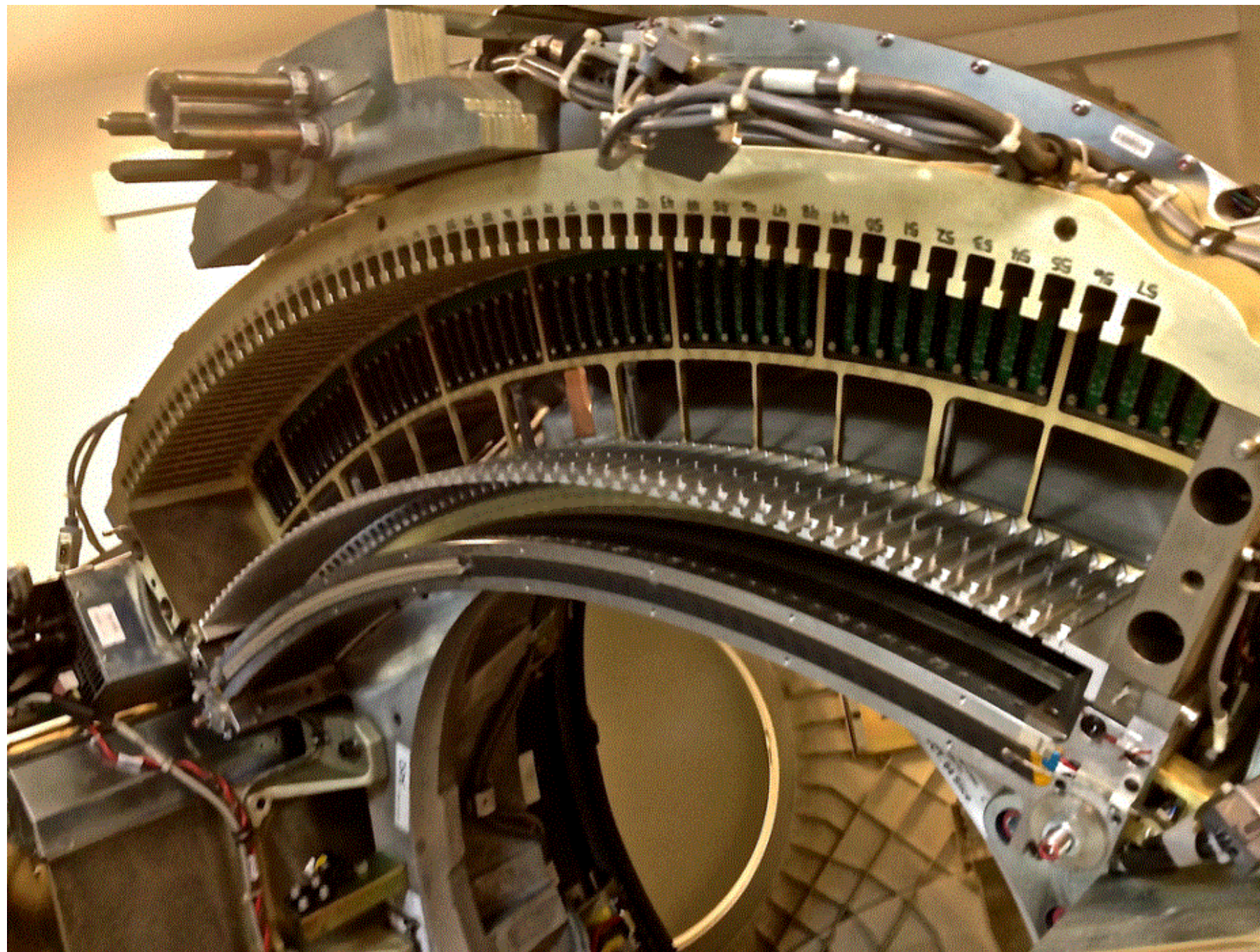
Source .



VS.

Computed Tomography (CT)





(Jaime Salazar → flickr.com)

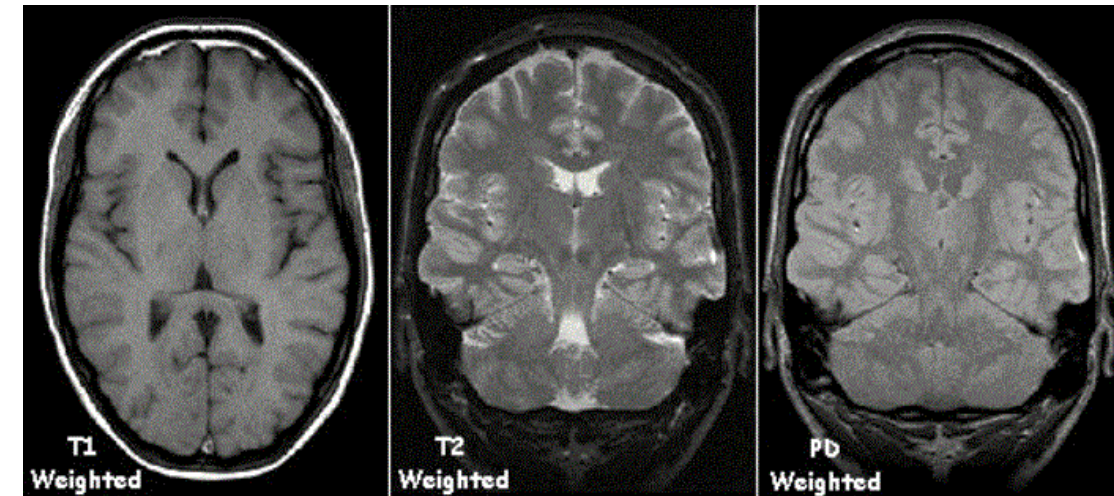
4.MRI Magnetic Resonance Imaging

Key concepts:

①

②

* MRI images show the distribution of _____ in the body.

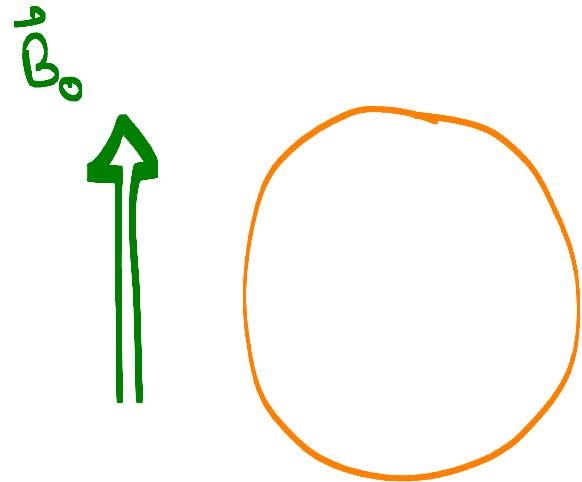


wikipedia

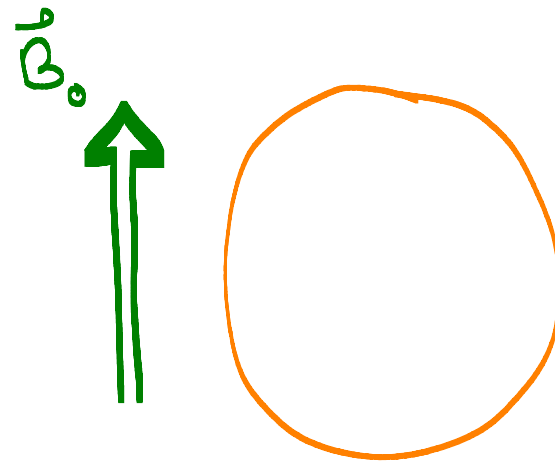
Q: How to measure tissue magnetization $\vec{M}(x,y,z)$?

A: Basically a 3-step process

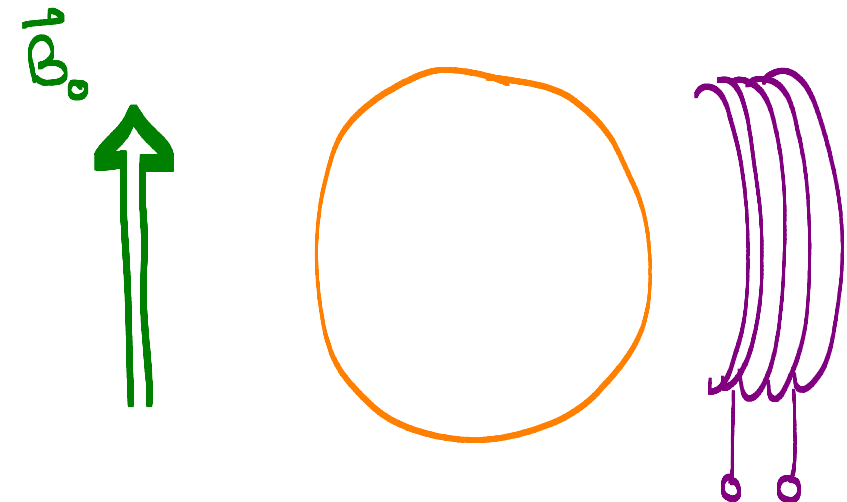
① Magnetize



② Tip



③ Record

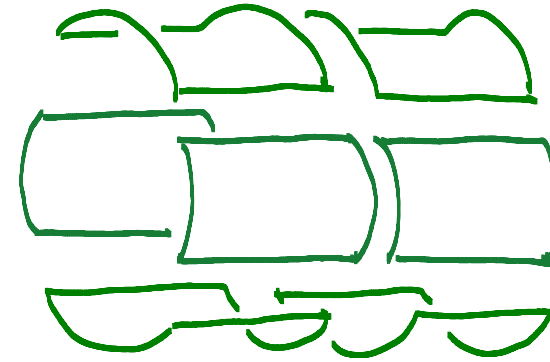
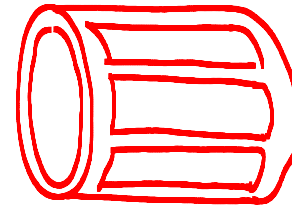
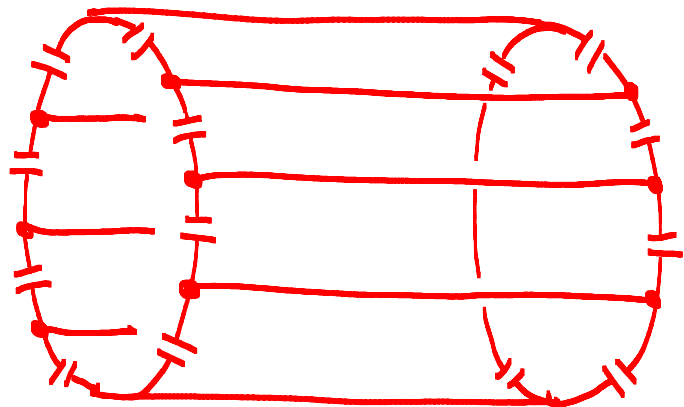


System Diagram

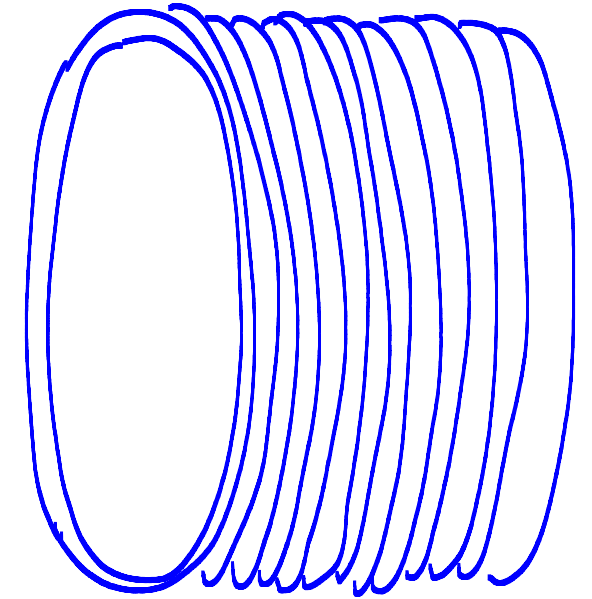
(16.11)



- Common design



- "Saddle coils"



Big solenoid

- Pulsed operation

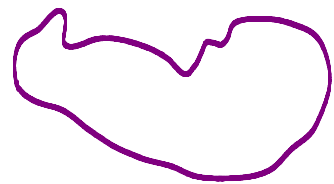
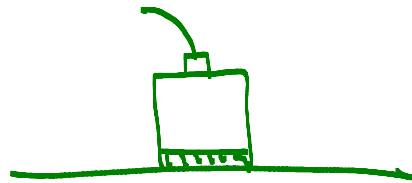
5. ultrasound

(16.12)

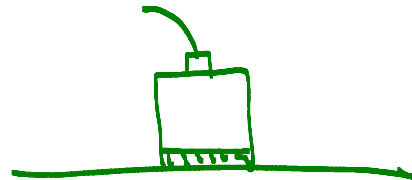
- Key Concept

★

①



②

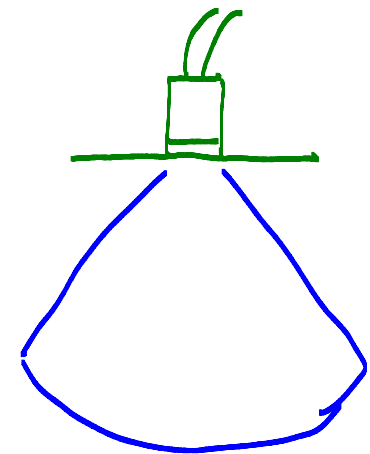


philips



- Frequency :

- Imaging time :



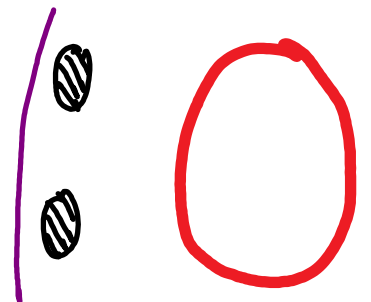
- Ultrasound Transducers

- For MHz frequencies,
use the _____

- Clinical systems use _____
to quickly scan ultrasound beams
across the field of view.



- Commonly used materials



• Color Flow Imaging

A moving object produces an echo arrival time that is NOT constant.

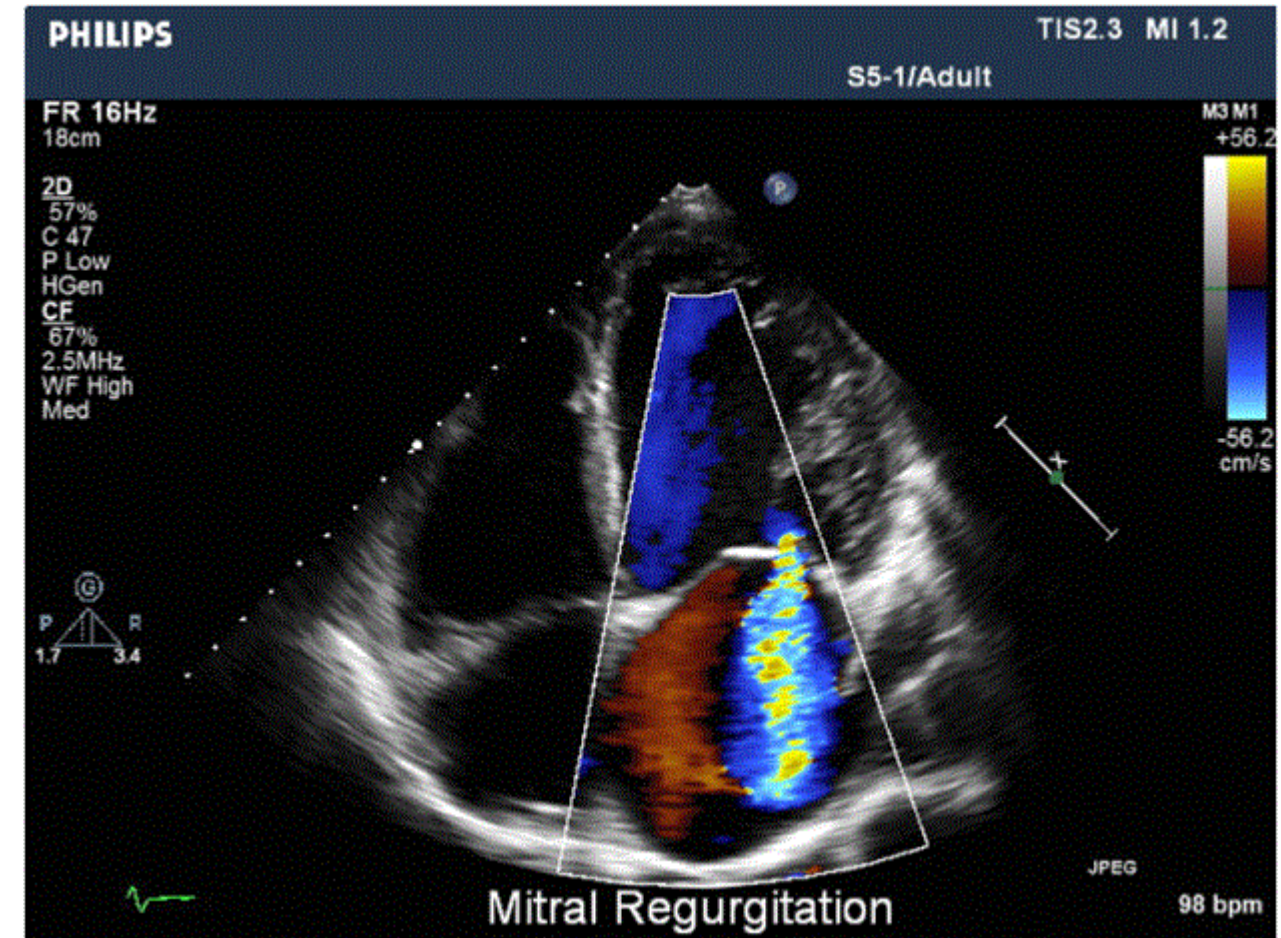
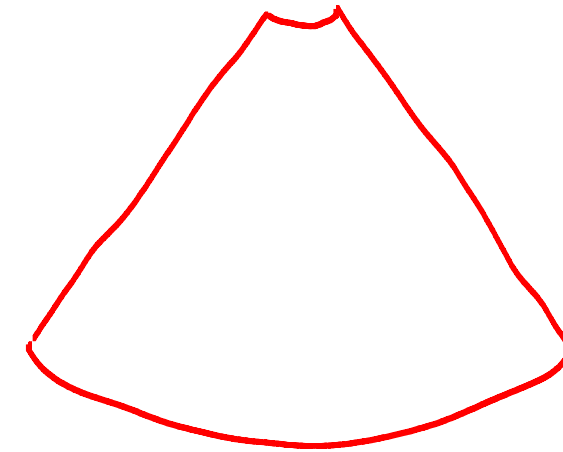
Ex: □ □ □ Transducer

•

•

• object

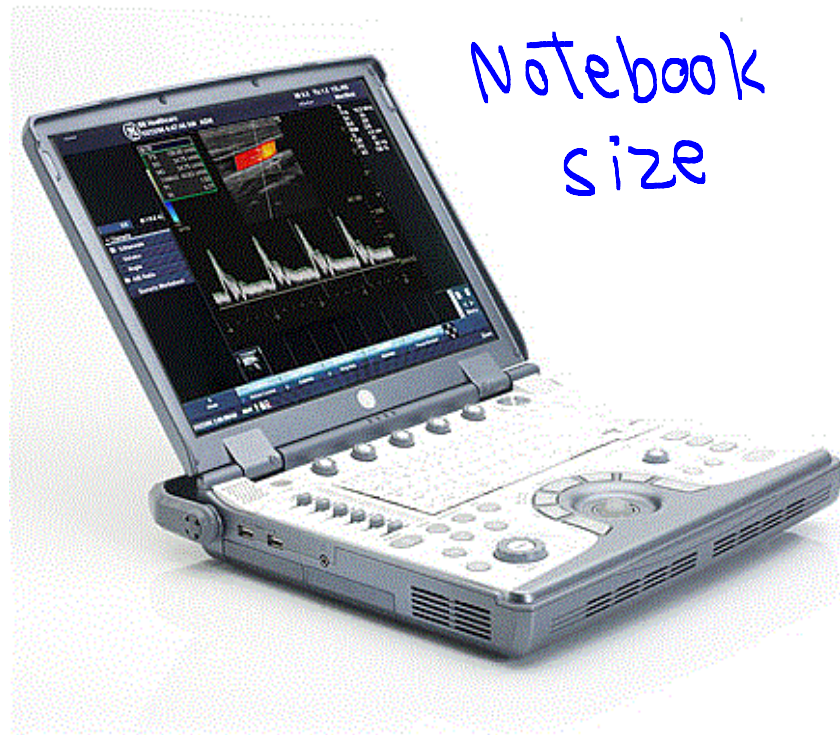
(16.14)



- Commercial systems come in many flavors...



Cell Phone
size



Notebook
size



Cart
Size

(GE)

(16.15)