


Medical Imaging Modalities

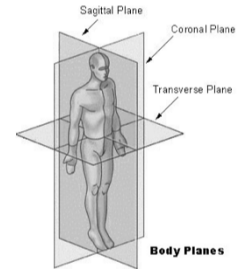
Methods In Medical Image Analysis—Spring 2012
BioE 2630 (Pitt) : 16-725 (CMU RI)
18-791 (CMU ECE) : 42-735 (CMU BME)

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Anatomical Axes

- Superior = head
- Inferior = feet
- Anterior = front
- Posterior = back
- Proximal = central
- Distal = peripheral



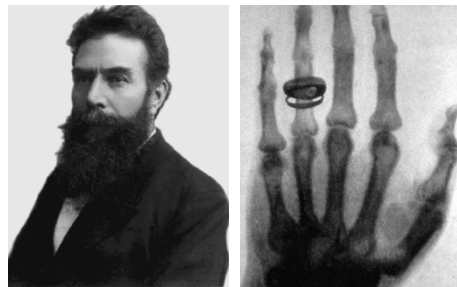
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Imaging Modalities

- Camera: Microscope, Endoscope, etc.
- X-Ray
- CT
- Nuclear Medicine
- Ultrasound
- MRI
- ...

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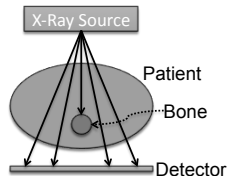
1896: The X-Ray



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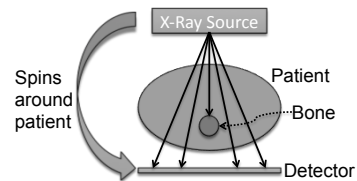
X-Ray & Fluoroscopic Images

- Projection of X-Ray silhouette onto a detector
- Measures densities
- 3D maps to 2D
- Detectors often use an intervening fluorescent screen to convert X-rays to visible light
- Fat, muscle, bone, contrast agent, metal



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Computerized Tomography



- Spin X-Ray source/detector around the patient
- From a series of projections, a tomographic image is reconstructed using Filtered Back Projection.

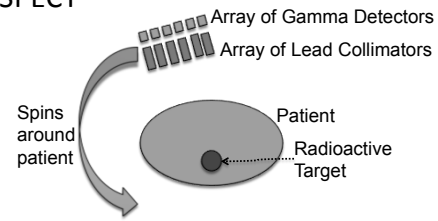
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Nuclear Medicine

- Previously discussed imaging modalities image anatomy (structure).
- Nuclear medicine images physiology (function)
 - At the cellular (and subcellular) level
 - Technically a type of molecular imaging
 - Requires use of radioactive pharmaceuticals

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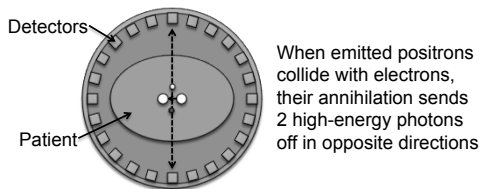
SPECT



- Single Photon Emission Computed Tomography
- Gamma camera for creating image of radioactive target
- Camera is rotated around patient

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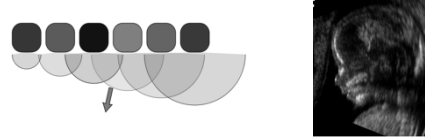
Positron Emission Tomography



- Positron-emitting organic compounds create pairs of high energy photons that are detected synchronously.
- No collimators, greater sensitivity.
- Attenuation is not location dependent, so quantification is possible.

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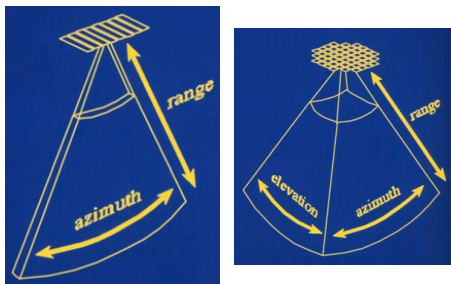
Phased Array Ultrasound



- Images anatomy
- Ultrasound beam formed and steered by controlling the delay between the elements of the transducer array

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Real Time 3D Ultrasound



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Other Imaging Modalities

- MRI & fMRI (will review later)
- OCT ("optical ultrasound")
- Pathology (in addition to Radiology)
- Other modalities coming down the pike

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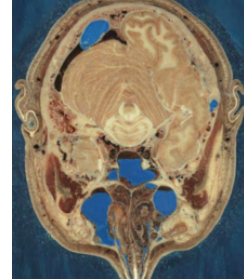
Current Trends in Imaging

- 3D, 4D, ...
- Higher speed
- Greater resolution
- Measure function as well as structure
- Combining modalities (including direct vision)

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The Gold Standard

- Dissection:
 - Medical School, Day 1: Meet the Cadaver.
 - From Vesalius to the Visible Human



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