University of Al-Mustaqbal
College of Science
Department of Medical Physics

Medical Imaging

Second Stage

Lecture 1: Introduction to the medical imaging

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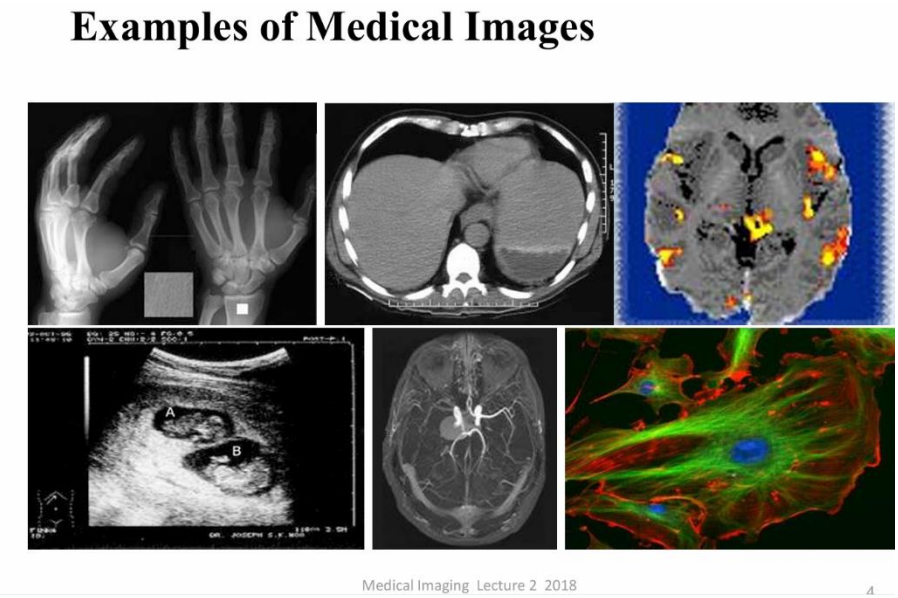
Medical imaging

Medical imaging is the branch of medicine that uses various technologies to create visual representations of the inside of the human body for **clinical diagnosis, monitoring, and treatment planning**. It allows healthcare professionals to view organs, tissues, bones, and physiological processes without invasive procedures.

Medical imaging includes techniques such as **X-ray, Computed Tomography (CT), Magnetic Resonance Imaging (MRI), Ultrasound, Nuclear Medicine, and Positron Emission Tomography (PET)**. Each modality works on different physical principles and is chosen based on the clinical need. Overall, medical imaging plays a vital role in early disease detection, accurate diagnosis, guiding medical interventions, and evaluating treatment outcomes.



Medical imaging pipeline

Medical Imaging Pipeline refers to the sequence of steps involved in acquiring, processing, analyzing, and interpreting medical images to support clinical diagnosis and decision-making. It describes how raw data obtained from imaging devices is transformed into meaningful visual and quantitative information.

The pipeline typically begins with

1. Image Acquisition: where medical images are captured using modalities such as X-ray, CT, MRI, or ultrasound.

2. Image Reconstruction: especially in CT and MRI, where raw signals are converted into image form.

3. Image Preprocessing: which includes noise reduction, contrast enhancement, and correction of artifacts to improve image quality.

4. Image Segmentation: is performed to identify and isolate specific organs, tissues, or regions of interest.

5. Feature Extraction and Analysis: where important characteristics such as shape, texture, or intensity are measured.

6. Image Interpretation and Visualization: where radiologists or clinicians analyze the results to make diagnoses, guide treatment, or monitor disease progression.

Overall, the medical imaging pipeline ensures that medical images are accurate, clear, and clinically useful, playing a crucial role in modern healthcare and medical research.

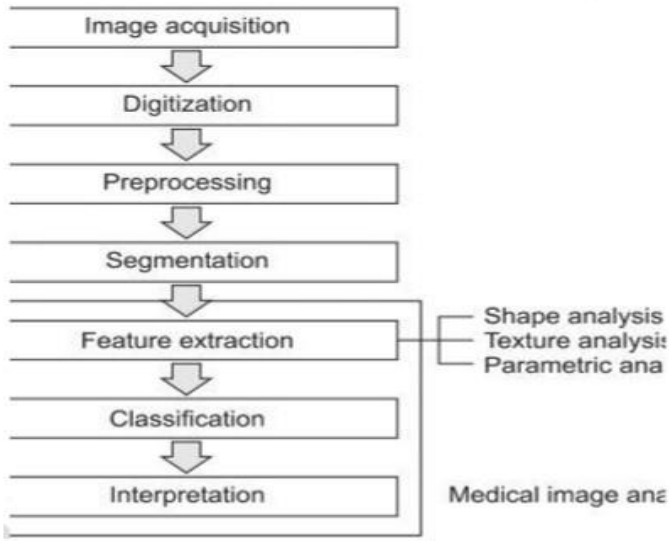
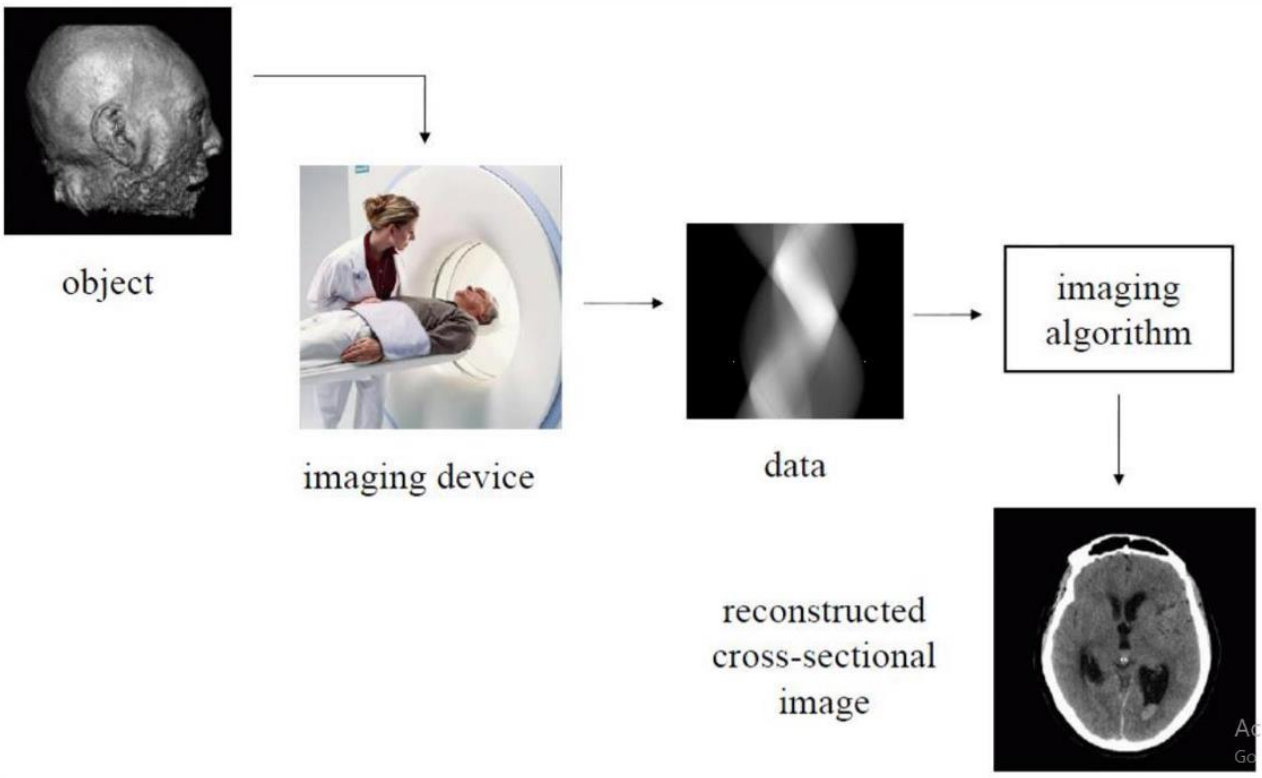


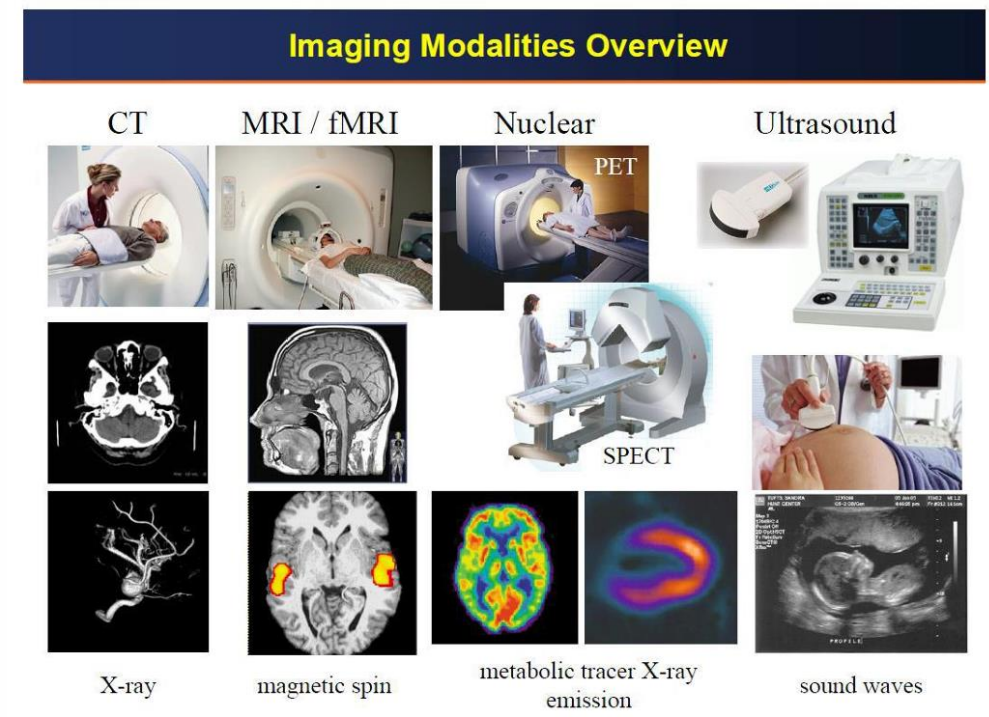
Image acquisition
Digitization
Preprocessing
Segmentation
Feature extraction
Classification
Interpretation
Shape analysis
Texture analysis
Parametric ana
Medical image ana


object
imaging device
data
imaging algorithm
reconstructed cross-sectional image

Medical imaging devices

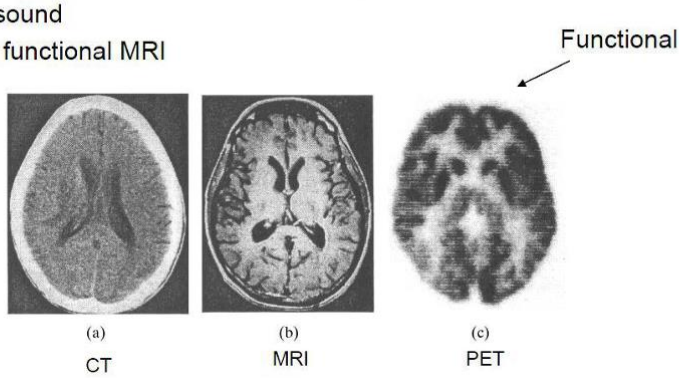
Here are the **medical imaging devices presented in bullet points**, suitable for lectures:

- **X-ray:** used to image bones and the chest; helps diagnose fractures and lung diseases.
- **Computed Tomography (CT):** produces detailed cross-sectional images of the body and is used to examine internal organs, injuries, and tumors.
- **Magnetic Resonance Imaging (MRI):** uses magnetic fields and radio waves to create high-contrast images of soft tissues such as the brain, spinal cord, and joints.
- **Ultrasound:** uses sound waves to image internal organs and monitor pregnancy without exposing the patient to ionizing radiation.
- **Nuclear Medicine:** includes techniques such as **PET** and **SPECT**, and is used to evaluate organ function and metabolic processes.
- **Fluoroscopy:** provides real-time moving images and is commonly used to guide medical procedures and observe organ motion.



Anatomical vs. Functional Imaging

- Some modalities are very good at depicting anatomical (bone) structure
  - X-ray, X-ray CT
  - MRI
- Some modalities do not depict anatomical structures well, but reflect the functional status (blood flow, oxygenation, etc.)
  - Ultrasound
  - PET, functional MRI



Anatomic vs Functional Imaging