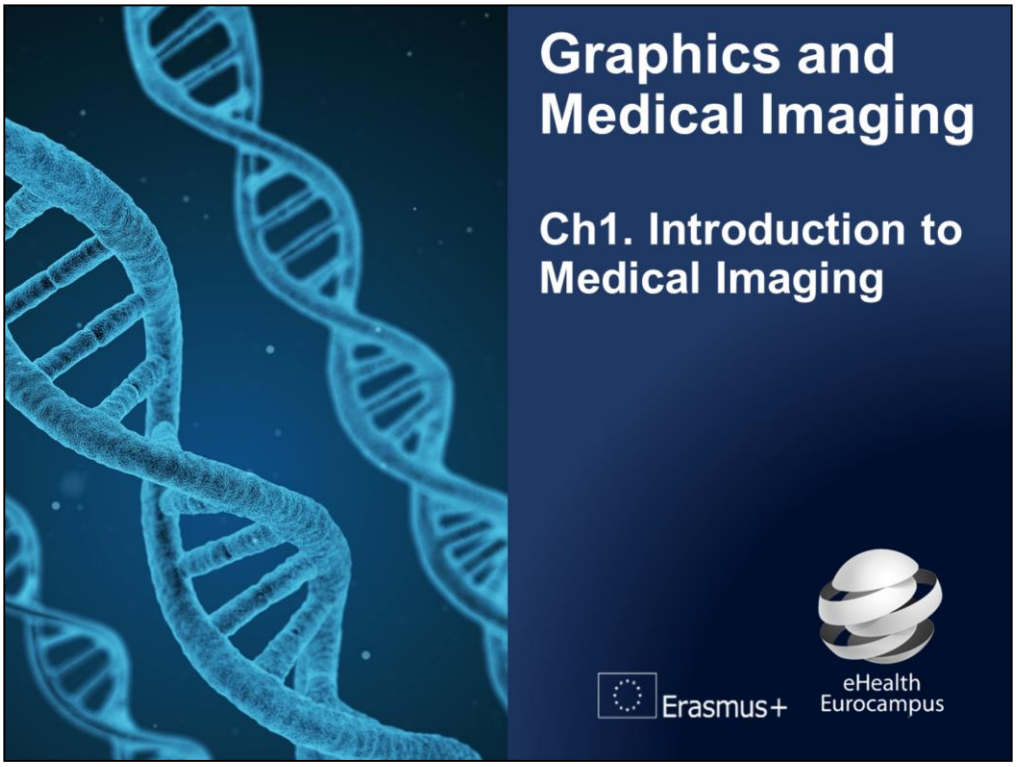
Graphics and Medical Imaging
Ch1. Introduction to Medical Imaging
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Course content

- ***PART I.1: Medical Imaging – Introduction***
- *PART I.2: Medical Image Processing*
- *PART I.3: medical Image Analysis*

- *PART II: Virtual Environments & Advanced Computer Graphics*

- *PART III: Game Design*

Index

- Introduction to medical imaging
- X-Ray imaging
- Computerized tomography imaging
- Nuclear imaging
- Ultrasound imaging
- Magnetic resonance imaging

Material based on and images taken from the UPM master degree in biomedical engineering

Introduction

- Medical imaging main objectives
  - Diagnosis: disease detection
  - Monitoring: disease development evaluation
  - Planning: correct procedure during surgery
- How are generated?
  - Capturing and converting the interaction between a type of radiation and human tissue
  - Clinic information is obtained from the observation of this recorded interaction

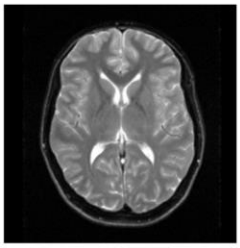
Medical imaging types

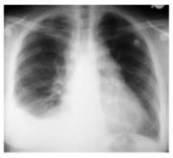
- Anatomical vs functional imaging
- Emission vs transmission imaging
- Projection vs Tomographic imaging

Anatomical vs functional imaging

Anatomical

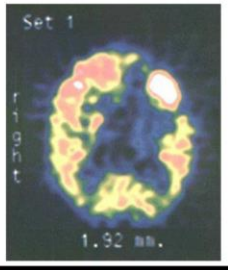
Distinguish between the different substances present in the organism: water, bone, soft tissues, …

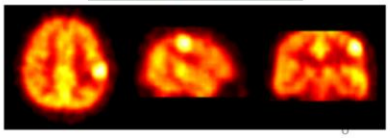




Functional

Discriminate different metabolism levels, measured depending on a certain biochemical activity.

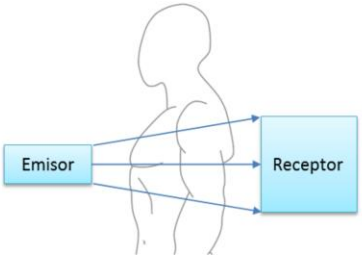




Transmission vs emission imaging

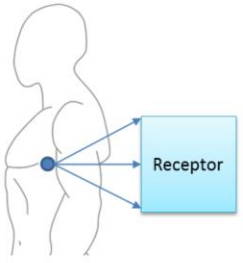
Transmission

Irradiation of the area of interest and study of its interaction with biological matter (X-rays, magnetic resonance).



Emission

Internal radiation source, artificially induced (nuclear medicine) or natural (thermography).



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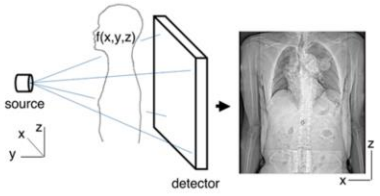
Projection vs Tomographic imaging

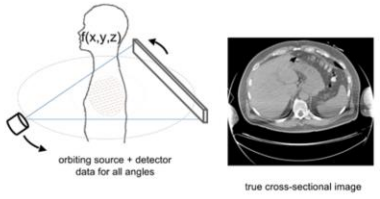
Projection

Single view: overlapped information without depth information.



Tomographic

Multiple views: information can be reconstructed and generate a volumetric image.



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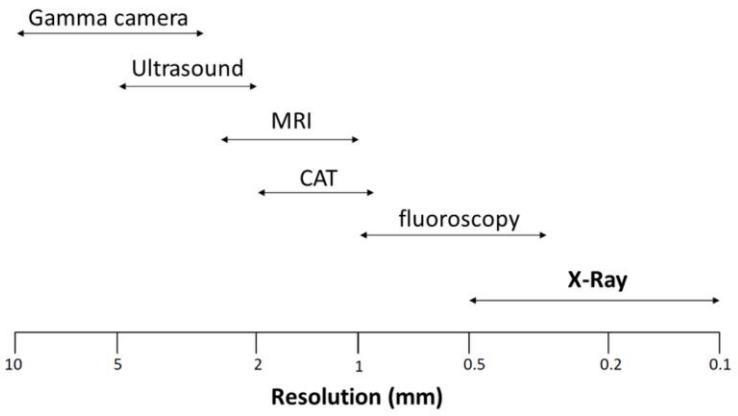
Medical Imaging Modalities

- X-ray imaging
- Computerized axial tomography imaging
- Nuclear imaging
- Ultrasound imaging
- Magnetic resonance imaging

Medical imaging spatial resolution



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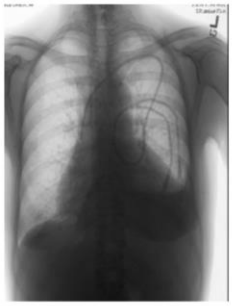
X-ray imaging

- **Image:** provides a measure of the attenuation of X-rays when they go through biological tissue.
- **Generation:** projection of a X-ray beam through the body human on a receptor sensitive to this type of radiation.



X-ray imaging

- **Problem of overlapping structures**

The X-ray beam represents at each point all the attenuation of the structures it has crossed, in some cases the clinical area of interest can be hidden under overlapping structures.

- **Contrast radiography**

Administration of a radiopaque dye. This test allows to evaluate structures that are not clearly evident on conventional X-ray exams.

CT imaging

- **Image:** same X-ray.
- **Generation:** multiple reconstructed projections of a X-ray beam through the body human on a receptor sensitive to this type of radiation.

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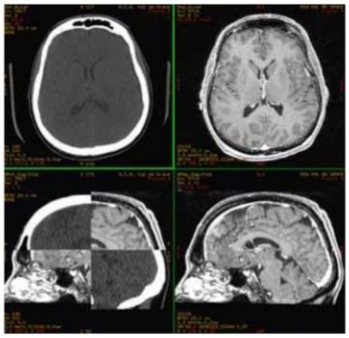
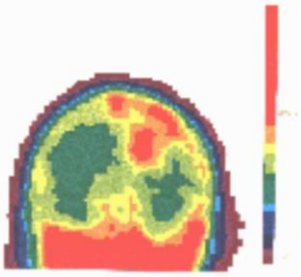
CT imaging

- Allows the visualization of superimposed structures and provides 3D information.
- Greater discrimination of the attenuation of the X-rays, increasing the range of tissue densities that can be visualized.



Nuclear imaging

- **Image:** measure of the location and concentration of a radioactive isotope.
- **Generation:** of a radioactive isotope along a traces is introduced into the human body, it attaches to the specific tracer target. Radiation is measured in a Gamma camera.

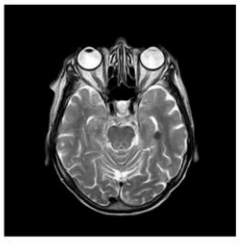


Ultrasound imaging

- **Image:** map of echo intensities, as a result of the interaction of ultrasound pulses with human tissue.
- **Generation:** emission and reception of multiple unidimensional ultrasonic beams.

Magnetic resonance imaging

- **Image:** three dimensional detailed anatomical images.
- **Generation:** MRI scanners use strong magnetic fields, magnetic field gradients, and radio waves to generate images of the organs in the body.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Conclusions

- The images are fundamental in medical practice and they have revolutionized medicine since the 20th century.
- Current and future medical imaging modalities and technologies allow better diagnosis, treatment and prevention of diseases.

Bibliography

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- Jerry L. Prince, Jonathan Links, Medical Imaging Signals and Systems, Pearson Prentice Hall, 2013
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