Introduction to Biomedical Imaging

General Description

This course is meant to be an introduction to biomedical imaging and will provide students with an overview of the key concepts behind the main imaging modalities used in diagnostic imaging.

The main emphasis will be on explaining the physical principles and algorithms underlying X-ray imaging, computed X-ray tomography, magnetic resonance imaging, single-photon emission tomography, positron emission tomography and ultrasound imaging. A secondary objective will be to introduce the student to some of the main elements of imaging systems and hardware that exploit the former principles and create biomedical images.

A small last section of the course will be devoted to introduce some basic concepts of biomedical image computing.

Pre-requisites

The course will be self-contained although students will benefit from having followed courses on mathematics, physics and image or signal processing.

Competences

General competences

After this course, the students will have been introduced to biomedical imaging and will have developed capabilities to understand how basic physics principles can be exploited to create biomedical images. They will have developed communication skills through seminars and capability for critical reading and thinking through paper readings and group discussions. Finally, in working in groups they will have to develop team work skills.

Specific competencies

After this course, the student should be able to:

- describe the most common techniques for generating biomedical images
- understand the physical principles, usages and limitations of each imaging modality
- enumerate which physical or physiological properties can be measured with each modality
- recognize the different imaging systems and their basic parts

Contents

- Introduction
- Physics of energy-matter interaction
- X-Ray radiography
- Digital X-Ray radiography
- Reconstruction from projections
- Computed tomography
- Principles of nuclear medicine imaging
- Nuclear medicine imaging
The course will be complemented with site visits to some of the local hospitals to see the imaging systems in place.

**Evaluation**

**Format**
The course will follow a continuous evaluation scheme that will take into account:
- seminar presentations (35%), pre-requisite for admission to final exam
- paper discussion (15%), pre-requisite for admission to final exam
- final exam (50%)

**General criteria**
Evaluation criteria that the student is expected to fulfil will include:
- critical thinking and ability to find relevant information
- ability to identify the main elements and gain intuition from new topics
- ability to work in a team while demonstrating personal involvement
- ability to present technical/scientific work in public with rigor

With respect to the technical elements for evaluation, the student should be able to critically understand all the material provided in the course and be able to expand or elaborate specific topics, provided the adequate time, in an autonomous manner or as part of team work.

**Resources**

**Physics and Systems of Medical Imaging**

**General and Biomedical Image Analysis**

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