UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Physical Sensors and Systems for Biomedical Imaging

2324-2-F9102Q020

Aims

The main aims of the course are three: i) to understand the physical principles on which medical imaging is based; ii) to familiarize with the main medical imaging techniques and understand their operating principles; iii) to acquire the practical capabilities to reconstruct and analyze medical images through standard and AI programming techniques.

Contents

The course will cover the fundamentals of medical imaging, including different types of imaging techniques such as radiography, CT, MRI, PET and ecography. In addition, the course will delve into the classical and AI techniques to interpret, reconstruct and analyze medical images provided by these instrumentations.

Detailed program

- Introduction to biomedical imaging and the physical principles underlying different imaging techniques
- Radiography and Computed tomography (CT): physics of photon interaction with matter, and operating principles
- Magnetic resonance imaging (MRI): physics of magnetism and nuclear resonance, and operating principles
- Nuclear medicine (PET and SPECT): physics of radioactive decays, and operating principles
- Ultrasound imaging, ecography, eco-Doppler: physics of wave and sound propagation and of the doppler effect, and operating principles
- Python environment for medical imaging: basic python concepts and available packages for medical imaging manipulation.
- Case study: medical image classification, comparison between different NN.- Case study: medical image

segmentation using a Unet

Prerequisites

Knowledge of basic physics, python and standard machine learning techniques

Teaching form

The classes will be in the form of frontal lectures and of computer laboratories in which students could work in groups.

Textbook and teaching resource

The main resource will consist of the slides and other materials (such as scientific papers) provided by the teachers during the lectures. Some recommended, but not mandatory, textbooks are:
J.T. Bushberg, J.A. Seibert, E.M. Leidholdt, J. Boone, The essential physics of medical imaging, LIPPINCOTT WILLIAMS & WILKINS, a WOLTERS KLUWER business
F. Chollet, Deep Learning with Python (ISBN: 9781617294433)
Other potentially interesting readings are:
P. Seutens, Fundamentals of Medical Imaging, Cambridge University Press
A.G. Webb, Introduction to Biomedical Imaging, IEEE Press, Wiley
Ian Goodfellow and Yoshua Bengio and Aaron Courville; Deep Learning; MIT Press; http://www.deeplearningbook.org

Semester

First semester

Assessment method

The assessment methods will consist of an oral or written examination about the theoretical concepts dealt during the frontal lectures and of a brief project on image reconstruction or
analysis that should be discussed in the form of a presentation.
(Exam modalities will be better defined next).

Office hours

Students can write an email to the teachers whenever they want in order to arrange an appointment.

Sustainable Development Goals

GOOD HEALTH AND WELL-BEING