IMAGING METHODS IN MEDICINE AND BIOLOGY

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General description
The course is intended to introduce the students to the broad range of technologies that are currently employed for medical imaging. This subject will allow students to acquire knowledge of the theoretical principles and technology and clinical applications of the advanced imaging modalities of computerized tomography (CT), magnetic resonance imaging (MRI), ultrasound, fluorescence, etc. The attention is focused on how the energies used in these imaging technologies are interacting with the human body and how the images are formed. A special attention is paid on the methods of isotope production and the new perspectives for radioisotope production in the National Laboratories of Legnaro, INFN within the frameworks of the Project SPES. The application of the general physical principles of image generation and visualization are studied in each particular imaging system. The most used methods of image formation and manipulation are studied. The advantages of the modern multimodality imaging systems with respect to the unimodal ones are reviewed.

The course consists of up to 24 hours (3 CFU) of lectures on the imaging methods exploited in biology and medicine. Complimentary parts to the lecture course (amount up to 30 hours) are the practical exercises in the Laboratory for Radiopharmaceuticals and Molecular Imaging (LARIM) at the National Laboratory of Legnaro, INFN. Imaging demonstrations and exercises are to be conducted on a mini gamma camera and eventually on a micro PET/SPECT/CT. In the laboratory can also be demonstrated two new imaging methods: the patented by the lecturer Tilting-collimator gamma-ray camera and multi-wavelength Near-infrared scanner. There is a great opportunity for students to work on theses on the characterization the imaging characteristics of a gamma camera or PET/SPECT/CT using traditional generator-produced or newly accelerator-synthesized $^{99m}$Tc isotopes, or to take part in the construction and the tests of the NIR scanner for Single-Walled Carbon Nano Tubes (SWCNT) laser-induced fluorescence.

A cycle of 3 seminars will complement the course program, dealing with topics related to current research activity of the speaker.

Working languages: English and Italian

Topics

2 lecture hours


2 lecture hours


2 lecture hours


2 lecture hours


2 lecture hours


2 lecture hours

7. Positron emission tomography (PET). PET scanning systems. Data acquisition and corrections. Image reconstruction. Performance characteristics of PET scanners.

2 lecture hours

8. Radionuclides for PET imaging. Production of PET radionuclides and synthesis of PET radiopharmaceuticals

2 lecture hours


2 lecture hours


2 lecture hours

11. Bioluminescence. Imaging in the Infrared (IR) and near-infrared (NIR) region. Use of nanoparticles for imaging in visible light and in NIR light

2 lecture hours

2 lecture hours

Laboratory exercises
(conducted in the laboratory LARIM at the National Laboratories of Legnaro, INFN)


   5 hours


   5 hours


   5 hours


   5 hours


   5 hours


   5 hours

Cycle of seminars entitled “From simple detection to imaging”

   Topics: General methods for production of radioisotopes for medicine. The problem of production of Technetium 99m for the medicine in view of the foreclosure of some of
the main reactors in Canada and Holland. (in this connection: Projects SPES, LARAMED and APOTEMA of the LNL, INFN). New perspectives for radionuclide production for medical purposes in the LNL, INFN (in this connection: the new cyclotron to come in the LNL).

Duration: 60 minutes

2. Imaging of small-size biological objects.


Duration: 60 minutes

3. Imaging using Near Infra-Red light


Duration: 60 minutes