EUTEMPE-RX Module 03:
Monte Carlo simulation of x-ray imaging and dosimetry

Aim and main outcomes

Monte Carlo simulation of radiation transport has numerous applications in medical radiation physics, largely due to its detailed modelling of radiation interactions and to its suitability for dealing with complex geometries. This course aims at providing medical physics experts with the theoretical and practical abilities required to efficiently use the general-purpose Monte Carlo code PENELOPE/penEasy to simulate x-ray imaging problems and their dosimetry. The coupling between ionising radiation and light, or electron-hole pairs, in conventional x-ray digital detectors will also be addressed in the context of the MANTIS code.

The main learning outcomes will be:

- Assess Monte Carlo algorithms for practical problems in x-ray imaging.
- Construct simplified models of x-ray transport problems to efficiently simulate them with PENELOPE/penEasy and MANTIS.
- Apply Monte Carlo simulation for the estimation of the absorbed dose to the patient.
- Manage a simulation project from beginning (conceptual modelling) to end (analysis of results).

Online and face-to-face phases

The module will use a combination of online content and face-to-face (f2f) sessions. The central components of the module, including guided practical exercises, will be presented during the f2f part, which will be undertaken over a period of one week.

The online phase will be split in two parts, one previous to the f2f phase and another after it. The pre-f2f phase, available online at the platform provided by EUTEMPE two weeks before the start of the f2f sessions, will be based on preparatory reading material and on the installation of and familiarization with auxiliary software used during the f2f part. The post-f2f phase will be based on forums to discuss more advanced exercises and further issues on the use of the simulation codes.

For more information

Dr Josep Sempau, email: josep.sempau@upc.es
Visit the EUTEMPE-RX website at http://www.eutempe-rx.eu

Face-to-face course

Contents

- Monte Carlo (MC) simulation of radiation transport:
  The MC method. Radiation transport. Variance-reduction techniques.

- Photon and electron EM physics:
  Photon and electron interaction models. Condensed simulation of charged particles. General-purpose codes.

- The PENELOPE/penEasy system:
  Distribution, structure and operation. Material and geometry data files.

- Physics of imaging detectors:
  Scintillators & semiconductors. Imaging metrics. Photon counters. Imaging simulation codes.

- The MANTIS system:
  Distribution, structure and operation. Material & geometry data files. Demos and applications.

- Exercises:
  Computation of absorbed dose distributions. Spectrometry. X-ray tubes & image formation. Dose distribution in voxelised geometries.

- Applications in diagnostic and interventional radiology

Lecturers

- Dr Josep Sempau, Technical University of Catalonia
- Dr José M. Fernández-Varea, University of Barcelona
- Dr Aldo Badano, U.S. Food and Drug Administration
- Dr Hilde Bosmans, Katholieke Universiteit Leuven

Dates & location

Late June 2017, exact dates still to be decided
School of Industrial Engineering of Barcelona (http://www.etseib.upc.edu),
5th floor room 5.2
Technical University of Catalonia (UPC)
Diagonal 647, 08028 Barcelona, Spain
https://maps.google.com/maps?q=41.384835,2.115628

Accomodation

University Residences (RESA) are a convenient and affordable solution. Please visit http://www.resa.es. In particular, the residence named Torre Girona is within walking distance (~10 min) of the course location in a quiet area.