A self-guided tutorial for treatment planning in radiation therapy

Computerized treatment planning for radiation therapy is an important part of the training of the Masters students in Medical Physics and the Oncology Physics registrars. Student feedback has shown that, due to the complexity of the treatment planning process, the MSc lectures on treatment planning were not sufficient to develop a sound understanding and feel for the planning process. The aim of this project is to develop a tutorial for students to apply their theoretical knowledge in a number of practical sessions in which they can explore the different features of a modern treatment planning system (TPS) as well as learning how to plan both simple and more complex treatments. Below is a list of key words that should be addressed in the tutorials:

Phantom:
- Single beam (6MV, 18MV)
  - Standard set-up (field size 10x10 cm, 100 SSD)
  - Effects of variation of field size and SSD on percentage depth dose curve (PDD)
  - Effect of inhomogeneity correction

Patient plan:
- DICOM import of CT slices
- Anatomical reference point
- Contouring
  - Skin
  - GTV, CTV, PTV
  - OARs
- Isocentre placement
- Beams
  - Photon (6 MV, 18 MV)
    - Parallel opposed
      - No wedges
      - Wedges
    - 3-field
      - No wedges
      - Wedge
    - 4-field
      - (Electron)
- Beam shaping in Beams-eye-view (BEV)
  - Jaws
  - Conformal shielding blocks
  - Multileaf collimator (MLC)
- Plan normalization
- Manual beam weight optimization
- (Automatic beam weight optimization using DVH objectives)
- Dose grid
  - Size
o Resolution

• Dose calculation
• Plan evaluation
  o Point dose
  o Dose statistics
  o Dose planes
  o Dose volume histogram (DVH)
    ▪ Cumulative DVH
    ▪ Differential DVH
  o Biological models
    ▪ Tumour control probability (TCP)
    ▪ Normal Tissue complication probability (NTCP)
• Generation of digitally reconstructed radiographs (DRRs)
• Printout of patient plan
• DICOM transfer to “linac”

Note: the process of treatment plan simulation and patient marking as well as the actual set-up of the patient on the treatment couch of the linac can then be simulated in Augmented Reality (AR) scenarios -> based on related AR project.

Rather than providing step-by-step instructions the student should be given a task, which she/he should be able to complete, based on a basic tutoring booklet (including references on how to get more information if required). The tutorial should also include a quiz, e.g. “what is the volume of the prostate contour”, and challenges such as, “try to achieve a dose uniformity in the prostate of +/- 3% without exceeding the dose to the rectum.

Juergen Meyer
09.10.2008